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The Modern Theatre

By E. M. Mlinar

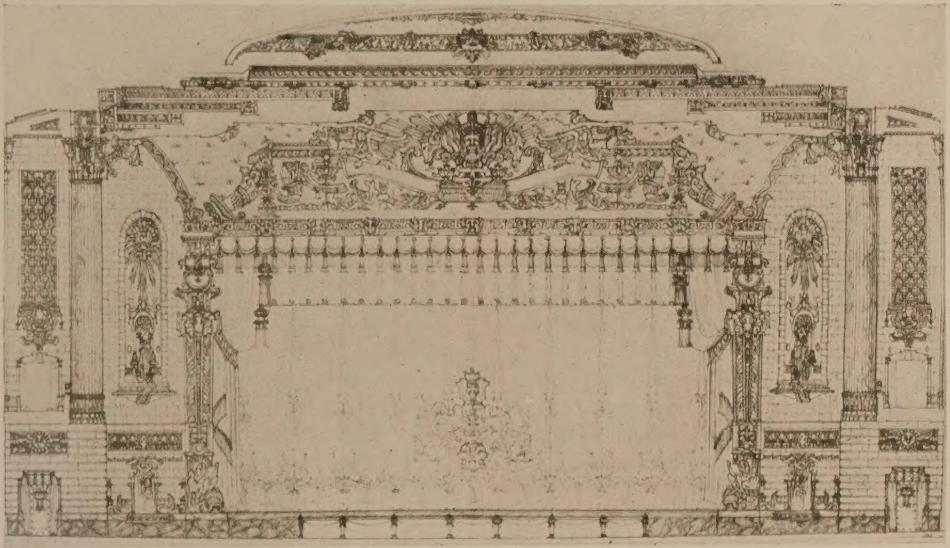
THE present activities shown throughout the United States in theatre construction are such as never before known in the history of the modern theatre. The demand is so great for good plots for theatres that in many instances large office-buildings are planned with a theatre adjoining, and I note in some Western cities hotels and department stores are giving way to space for the construction of the theatre in portions of the building.

Since the advance made in moving-picture productions and the interesting manner of presenting the picture to the public with a varied sort of entertainment, large corporations outside of theatricals have taken interest in the theatre, and I am well informed that in one instance such a corporation is planning to build 1,000 theatres, of about 1,600 seat capacity, to be distributed throughout the smaller towns of the various States.

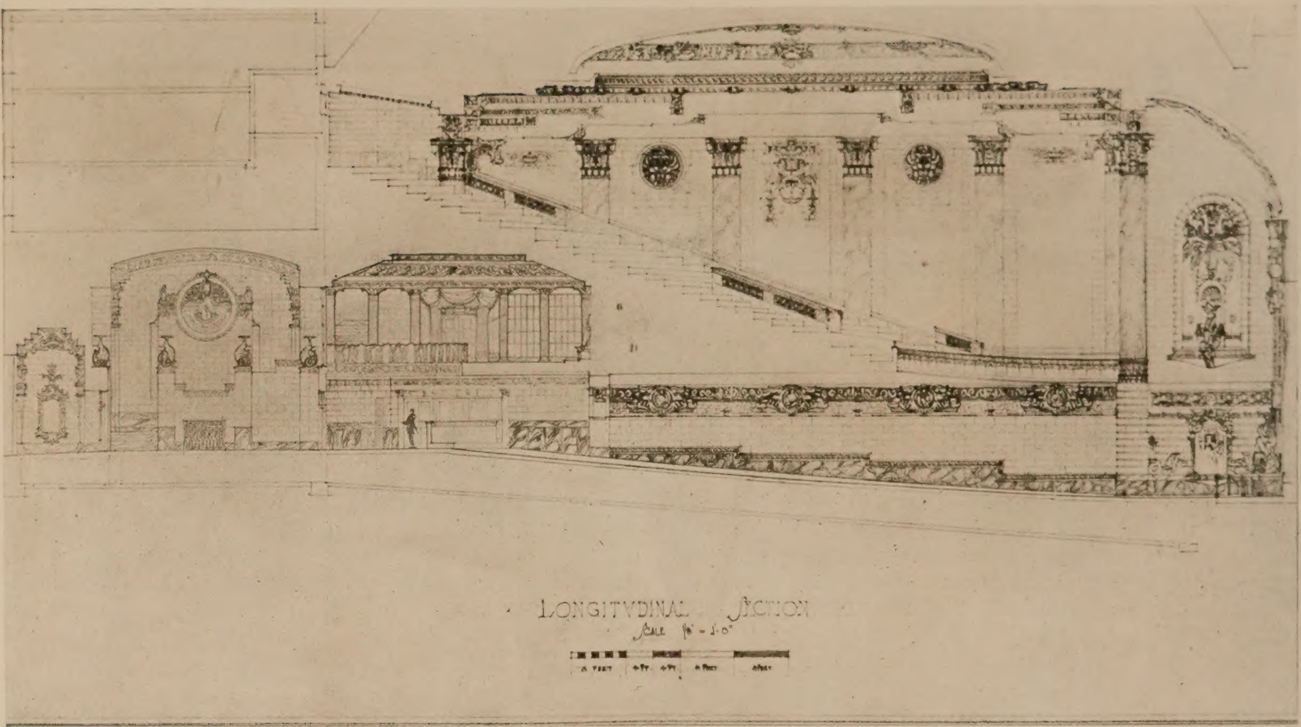
At present there are three types of theatres: first, the legitimate playhouse; the motion-picture theatre arranged as a concert-hall; and the combined picture and vaudeville house.

The requirements of each and every one vary, and it is a credit to the profession to note that the architects engaged are giving proper study to their plans to meet these requirements.

The concert-hall and vaudeville type of theatre being most in demand, seating between 2,500 and 3,500 persons, the conditions and various requirements for the proper handling of the theatregoers are far more intricate than in the legitimate house, owing to the continual entrance and exit of patrons. The lobby in this instance is a very essential thing, and should be planned so as to permit the handling of an overflow crowd awaiting the end of any one performance. It is necessary to provide an entrance-vestibule which contains the ticket-office on the outside, then the outer lobby to provide for the overflow, having also a ticket-booth, then the grand lobby. The grand lobby has the stairs leading to the mezzanine promenade, and very careful consideration is needed in the planning of the staircase leading to the mezzanine. There is a certain amount of psychology connected with this detail, since people are inclined to avoid the climbing of stairs; however, if carefully planned, such a feeling can be overcome. Some architects have attempted to overcome this condition by the use of ramps leading to the mezzanine. However, this is not satisfactory, not only because it mars the beauty of the lobby, but ramps are very tiresome, and by providing a well-designed staircase, centrally located, it has the tendency to draw people to that part of the building to which the stair leads. This is evident in New York with the largest theatre in the world, having some 5,000 seats, where the staircase leads to the mezzanine, which takes care of the overflow crowd of the balcony.


Architect's study of interior for theatre, Los Angeles, Cal. Thomas W. Lamb, Architect.

In the planning of the orchestra it is interesting to note that architects are now providing sufficient standing-room. This is very essential. However, in this connection the sight-line of these people must be considered when standing, as in some instances it is very annoying when one standing in the rear of the orchestra cannot see the top of the picture being presented. This, of course, is due to the at-



Architect's study for section of theatre, Los Angeles, Cal. Thomas W. Lamb, Architect.

tempt to keep the building down in height, which could be done otherwise, and would eliminate the squatty effect so evident in most theatres in back of the balcony overhang.

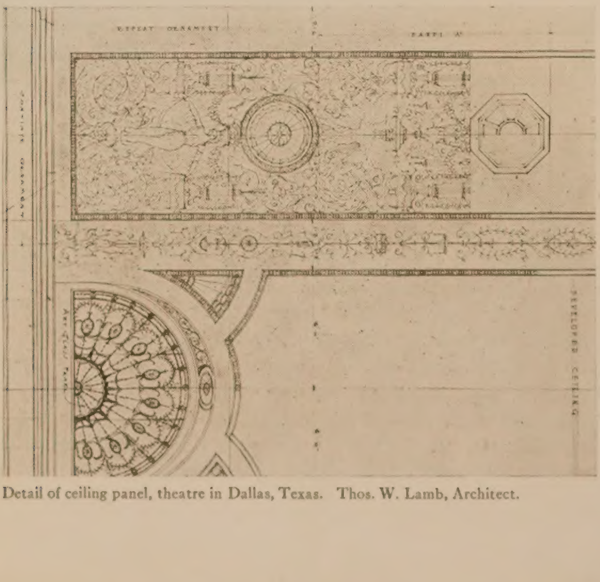
Owing to the new laws of the municipal authorities on gradients permitted, it is very difficult to provide the proper sight for patrons in a house having more than 25 rows, and necessitates the use of a different gradient, and steps under the seats to give the proper sight. This matter is of great importance and needs very careful study.

In connection with the planning of the orchestra, careful consideration must be given to the sanitary requirements—the men's and ladies' rooms and toilets adjoining. This seems to be neglected, and the proportion of fixtures required to the total seating of patrons is not properly taken.

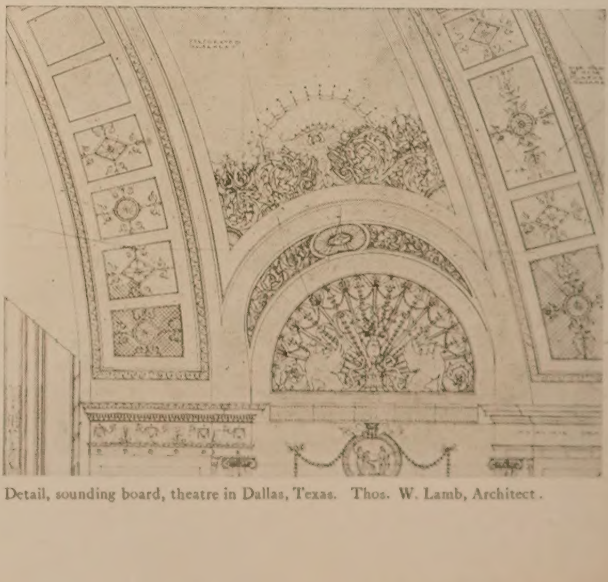
In the type of theatre described, the mezzanine promenade is most essential. It should be spacious and carefully designed, with facilities to handle a crowd.

A very interesting point in the planning of the mezzanine is the provision of a so-called well-hole, located in the centre, which serves many a purpose. It avoids the crowding ceiling effect over the patrons in the rear of the orchestra, and permits the patrons to hear the orchestral selections in the case when seats are not to be had in the balcony. Here also proper provision should be made for men's and ladies' rooms and toilet facilities, which should be calculated to the proportion of the balcony seating. The entrance from the mezzanine to the balcony must be located carefully. Usually two such passages, one each side, are sufficient. These passages lead to the lower crossover of the balcony and the loges; also from this mezzanine stairs are required to the higher level of the balcony or the second crossover; these also should be placed one each side.

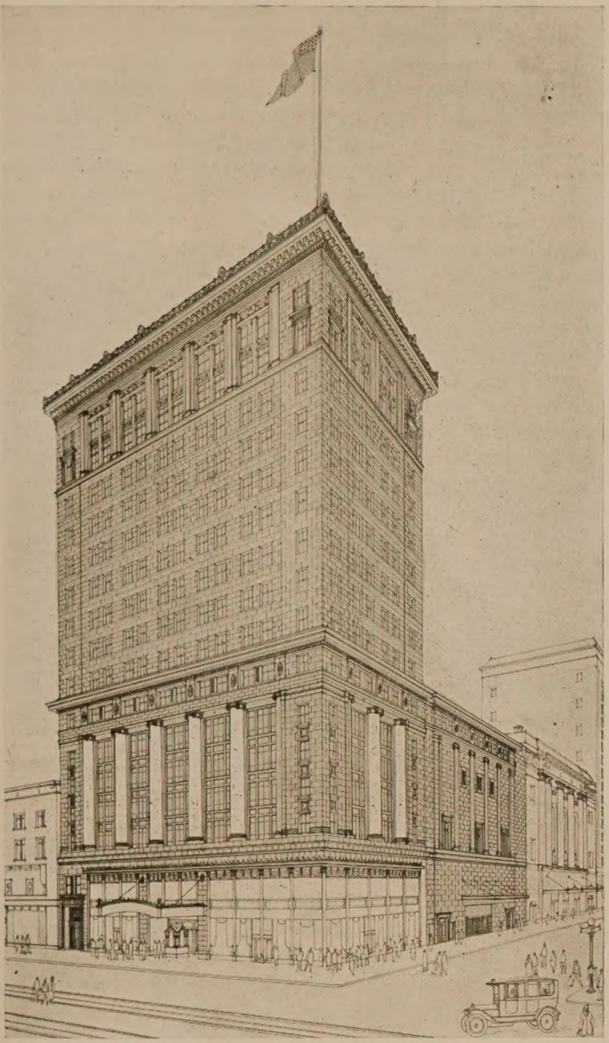
Entering the balcony of this type of theatre, it is very easy to note at once the difference between this type house



Detail of ceiling panel, theatre in Dallas, Texas. Thos. W. Lamb, Architect.



Detail, sounding board, theatre in Dallas, Texas. Thos. W. Lamb, Architect.



Design for State Theatre and office building, New York. Thos. W. Lamb, Architect.

and the legitimate theatre: the steppings are much shallower, and should not be over 13 inches, whereas in the legitimate theatre they are in some cases as high as 21 inches. The saving in the height of building can readily be seen by this comparison.

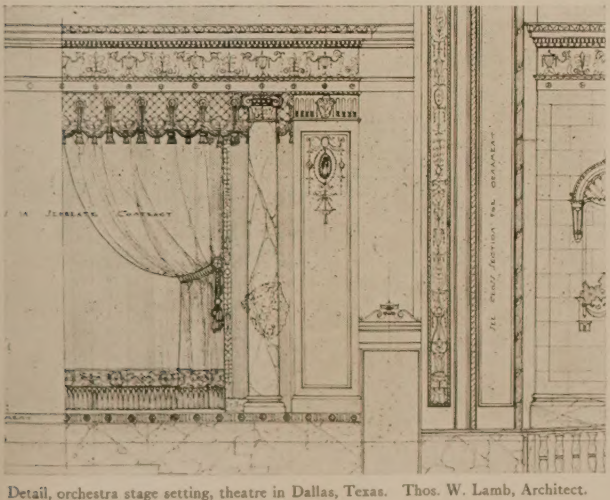
Two balconies should not be used for this type of theatre; as a matter of fact, the second balcony is being omitted in the new planning of the modern theatre. I have witnessed this in several of the large vaudeville-circuit theatres in the East, and it seems to work out most satisfactorily.

The picture-booth in most cases is placed in the rear of the balcony. It is interesting in some cases where the architect has placed the booth entirely on the outside of the building, cantilevered out from the rear wall of the balcony. This is a very good solution, as it does not break the seating in the rear of the balcony, nor does it interfere with the ceiling treatment.

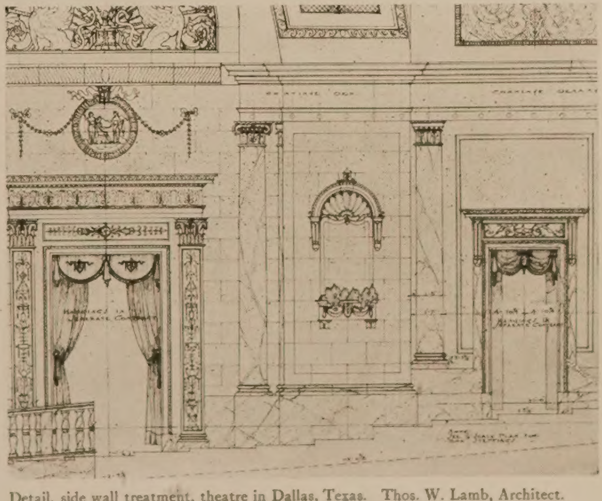
The general interior treatment of the auditorium is the next item worthy of note. Credit is due the architect who gives the balcony patron a treat on the side-walls rather than confining all his architecture to the orchestra and proscenium treatment. Somehow, too much has been done for one and not enough for the other, but from my observation this is now being well taken care of. In connection with the ceiling treatment of the auditorium, most theatres now being erected contain a central dome, which should not be dwarfed, as it has certain effects on the acoustics, a subject not to be tampered with. The dome is mostly used, however, for lighting effects, there being installed from three to four color lighting in coves. This eliminates a lot of ceiling fixtures, and also gives the producer a chance for effects to suit his production. As for acoustics, the curved sounding-board or proscenium and ceiling dome seem the most practical, yet the flat-beam-ceiling treatment has given equally good results, although in this particular possibly one of the most beautiful theatres in the United States has been a failure in the sense of acoustics on this account.

The stage, a prime essential, is a subject also greatly neglected, the relation of the working parts not being properly considered. In the vaudeville house dressing-rooms are required, which should be placed in proper relation with the working side of the stage, the working side being that side providing space for switchboard and pin-rails, also scene space. They should be placed opposite one another. The gridiron is the subject also neglected. In this type of theatre, if placed 60 feet above stage, it is sufficient to take care of all conditions provided that only vaudeville acts are to be handled; however, if the stage is arranged for any spectacular features, 80 feet is better proportion. This depends, of course, on the use of the stage.

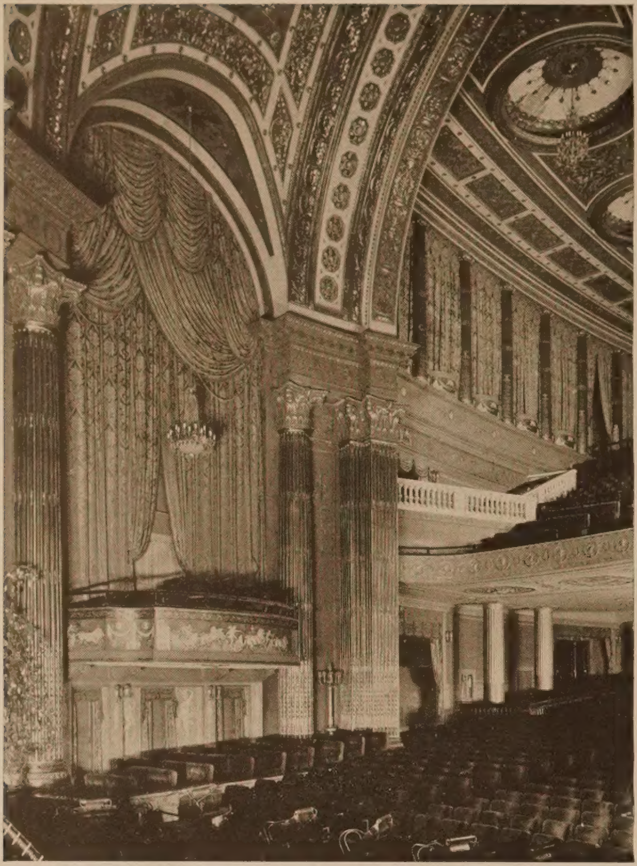
In the vaudeville and concert-hall type 60 feet is sufficient; this permits a 28 or 30 feet high proscenium opening.



Detail, orchestra stage setting, theatre in Dallas, Texas. Thos. W. Lamb, Architect.



Detail, side wall treatment, theatre in Dallas, Texas. Thos. W. Lamb, Architect.



Sounding board and proscenium treatment, also showing balcony side walls, Capitol Theatre, New York. Thos. W. Lamb, Architect.

The concert-hall type of theatre has the orchestra sitting on the stage proper, having a higher dais for the soloist and the picture-screen. I was very much surprised to see in one instance of this type house that the architect had left but 2 feet of space back of the screen and rear wall for any special setting for the soloist. This hardly permitted a passage in the back, much less allowed a set to be placed in back of screen when raised. Space should be provided so as to permit a ballet and a regular set; therefore, the minimum for this in my judgment should be 5 feet.

In the heating and ventilating of the theatre, and especially in this type of building nothing should be overlooked to give the best possible service, as the success of the theatre is greatly dependent thereon, owing to the same being in operation during all seasons. It is hoped that owners of theatres will permit the installation of such a plant as the architect suggests, though for reason of expense this is often neglected. Special patented and speculative ventilating schemes, of which there are many, should not be used. Sad experiences in this respect have taught many an owner and architect a lesson.

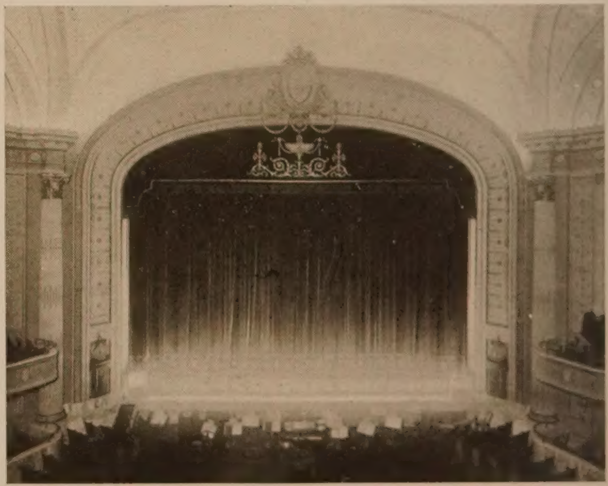
The particular use to which the theatre is to be put is the first consideration in determining what system of lighting must be employed. However, all theatres have a great deal in common, and with the exception of the small moving-picture house, all are provided with a stage, all have auditoriums, either large or small, and all have some kind of lobby, and a façade which require lighting.

As far as the façade is concerned, it is unfortunately in most instances used for advertising purposes. For advertising electrical display lighting is required to announce a particular play or production. It should be the object of the architect to design the face of a building so that a sign could be installed without hiding all of the architecture, or the architect should take it upon himself to design the building and sign at the same time, so that architectural unity may result.

The marquise is a very important element in the exterior design. This not only serves its original purpose as a shelter but when properly lighted has an indirect advertising value. It is not unusual to outline the marquise in panels with as many as four or five hundred lamps. The particular object of this style of lighting is to make a bright spot in what might otherwise be a dark street. In addition to performing its utilitarian purpose and that of light attraction, the marquise has been impressed into service for direct advertising. Attraction signs are attached to the sides and front, and projectors to illuminate the façade may also be hidden on it.

In the latest house erected in New York, the façade, on which there are no signs whatever, is lighted by flood-lighting which emphasizes the architecture. The only signs on this particular building are small ones (the name of the

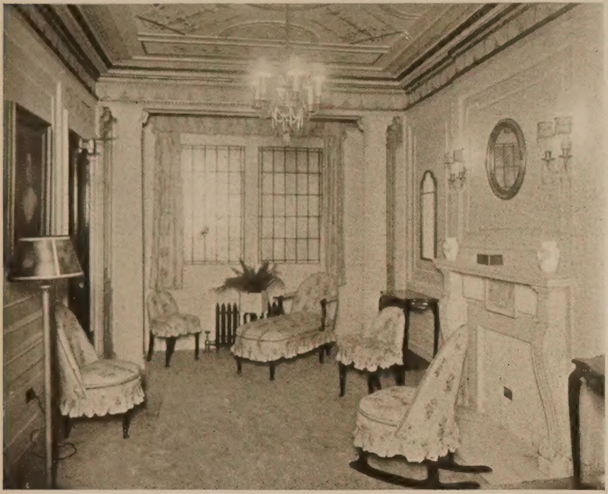
Inner lobby, theatre in Brooklyn, N. Y. Thos. W. Lamb, Architect.



Detail looking toward stage, showing effect of cove footlights. Theatre in Brooklyn, N.Y. Thos. W. Lamb, Architect.

theatre) at either end of the marquise. Underneath the marquise and against the building is a changeable attraction sign giving the attraction for the week.

The lobbies, halls, and anterooms require very little comment, as their problems are simple. As a rule these portions of the house constitute just so many rooms, each of which must have its lighting equipment designed to meet the views of the architect. Considerable cove-lighting is done at present, and, where the height is sufficient to erect a dome, this style is particularly to be recommended. Panel-lighting is also used. This consists of diffusive glass panels set in the ceiling behind which the lamps when properly spaced give a light effect without revealing the source of light. Considerable care must be exercised in the design of panel-lighting.



Ladies' retiring room, theatre in Brooklyn, N. Y. Thos. W. Lamb, Architect.

For the auditorium, there are quite a number of lighting systems and combination systems to select from. Direct fixtures, cove-lighting or panel-lighting combinations of any two or all three may be used.

In cove-lighting the shape of the cove is important. If the cove and dome are too flat the light will not be projected far enough to the centre and in this system of lighting the entire dome surface should be evenly flooded. The cove and reflectors should be properly designed for the purpose. There are domes of such great extent that it is practically impossible to entirely illuminate them from the cove. In such cases it is necessary to use a fixture to illuminate the surface that cannot be reached by the lights in the cove. Preferably, the fixture should be one of indirect type.

Grand lobby and part of main staircase, Capitol Theatre, New York. Thos. W .Lamb, Architect.

Panel-lighting alone should never be used in an auditorium, as this style of illumination does not permit enough light to reach the wall and ceiling surfaces to properly illu-

Third act of "Tannhäuser," Capitol Theatre, New York. Setting by John Wenger.

First act of "Lohengrin," Capitol Theatre, New York. Setting by John Wenger.

minate the decorations. In a number of houses that are exclusively so equipped, it has been found that the effect of the plaster detail on which a great deal of thought and money was expended is entirely lost. Therefore in planning this style of lighting sufficient wall-brackets or other light sources should be provided about the auditorium to accentuate the architectural details.

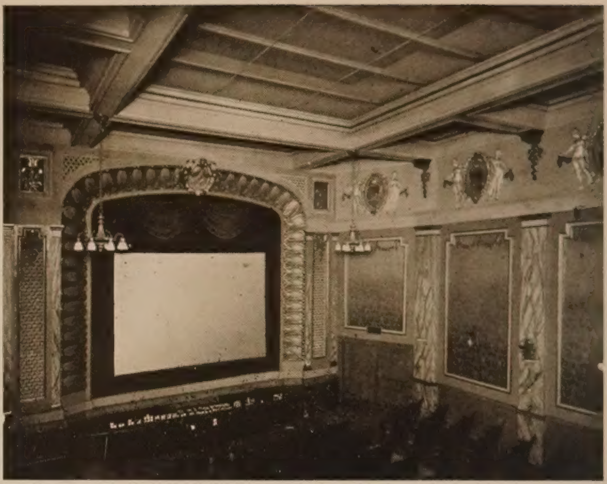
The combination of cove, panel, and fixture lighting usually produces a very happy effect. The main ceiling dome may be lighted with coves, some illuminated panels installed in the ceiling, and some also introduced into the soffit of the balcony, with brackets installed throughout the house to help in the general effect. The quantity of light to be used in both the coves and panels requires careful study.

In multicolored lighting we have a little different problem. The amount of white light introduced in color-lighting should be the same as though white lights only were to be used, and where colors are introduced they should be used in sufficient quantity to blend with the white lights. With the use of dimmers on the stage, effects can be obtained in color-lighting by means of various combinations which add materially to the effect of the dome and panels.

The question as to whether color-lighting shall be used in a house is one which should receive considerable thought. In a moving-picture concert house these effects are used in conjunction with the orchestration, and more or less with tableau on the stage. They are used in vaudeville houses which also show pictures.

The one important thing about the auditorium-lighting the architect must bear in mind is emergency-lighting. This usually consists of lights on double circuits which are placed on the walls in brackets, having one circuit controlled from the panel board in the box-office, and another circuit controlled from the stage switchboard, the particular object being to light the auditorium sufficiently for a dismissal of an audience in case of accident.

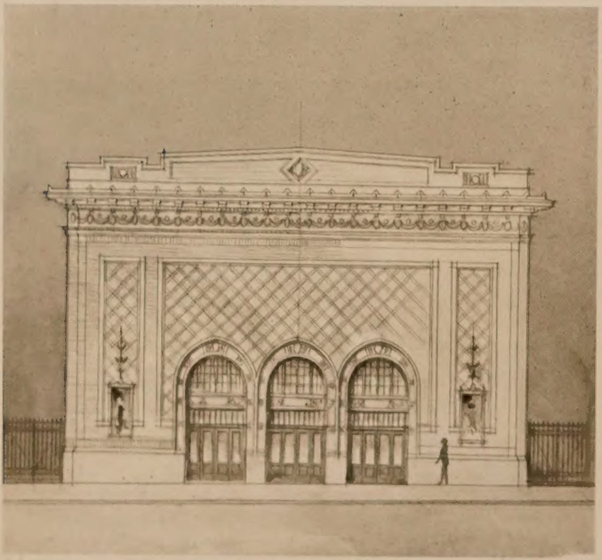
Stage-lighting to-day in principle is not very different from what it was years ago. There is usually a footlight, a number of borders, and certain spots. The footlight serves to throw light backward and upward, and the borders throw light downward and backward on the stage. In addition we have pockets for strips and for spotlights for special effects. The stage equipment will vary, depending on the character of the house. The vaudeville house should have a footlight of three colors with three or four borders, each of three colors, and in addition incandescent pockets either side



Ideal Theatre, New York. S. B. Eisendrath, Architect. B. Horwitz, Associate.

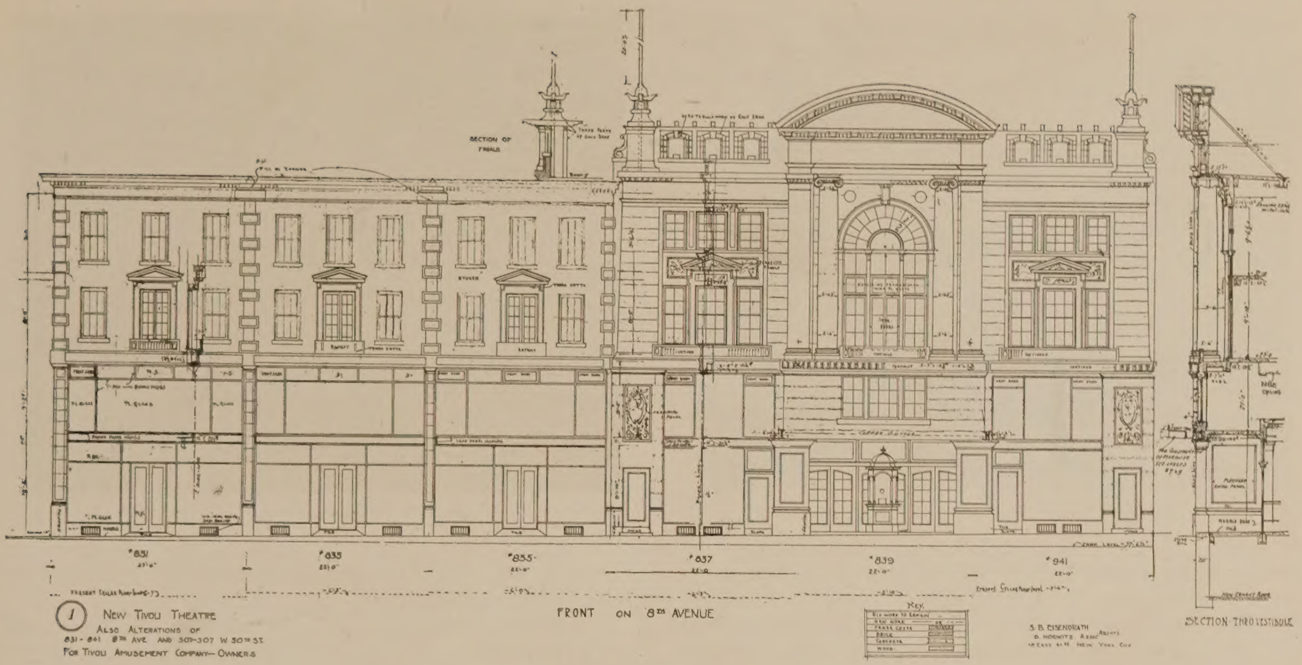
More than half of the entire roof over the auditorium is arranged to open by sliding on steel tracks so that in summer time the audience has the benefit of being practically out of doors, and therefore enjoys not only almost as much fresh air as a roof garden audience, but owing to the large size of the roof opening, the sky above is in full view from all parts of the auditorium.

Another feature is the skilful use of art-glass windows for lighting the interior by means of a series of oval shaped windows placed in the frieze as seen in the picture. In the daytime this glass subdues and colors the daylight so as to give the required light without artificial lighting, while the picture is on; and again at night these art-glass windows admit the same pleasing light by means of electric lights concealed behind the glass. In this manner both during the day and night time when the picture is on, the interior receives this beautifully diffused colored lighting and is entirely free from local electric lights, which are so annoying to the audience, and which more or less interfere with the effectiveness of the picture lighting.



Design for theatre on West 45th Street, New York (under constuction), for the Walk Realty Co. Eugene De Rosa, Architect.

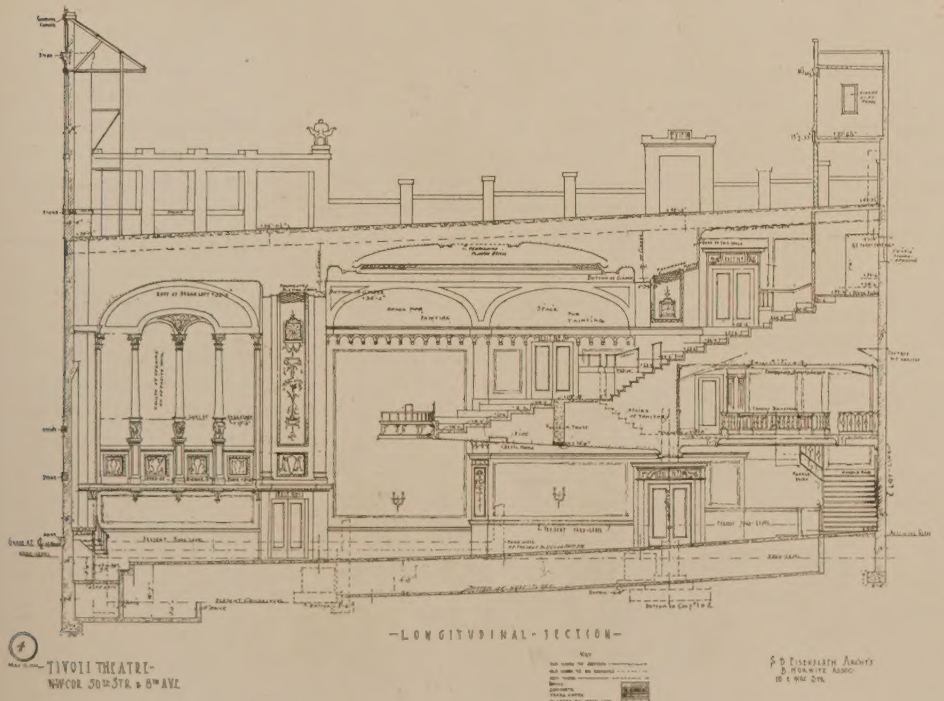
Design for Victory Theatre, New Brunswick, N. J. (under construction). John H. Scheier, Architect.



of the stage, and from two to a half dozen arc or spot pockets. An equipment such as this will light the average stage.

Where extravagant productions are given, such as some of the musical comedies, the stage-lighting is particularly heavy. A great many shows will require not only incandescent pockets of white only but incandescent pockets in colors—white, red, blue, or green, or amber—sometimes three colors, sometimes four.

In locating a switchboard it must be placed where the electrician can watch almost the entire stage. To get proper effects at the right time he must be able to watch for his cues. The slightest mistake in this direction will mar any show.



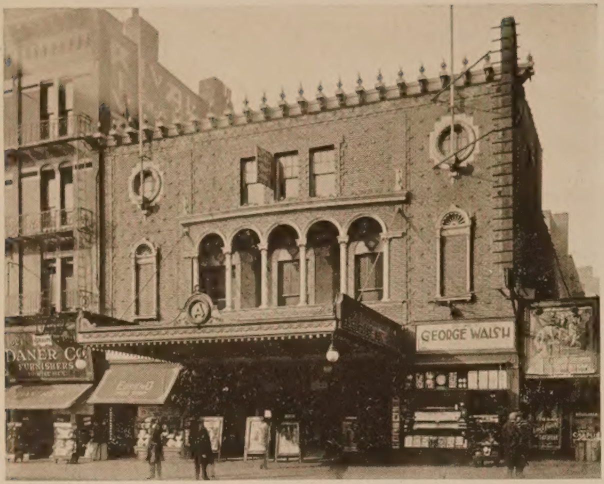
The switchboard itself should be of the "dead-face type," so as to be as safe as possible. A switch should be provided for each color in the footlight, for each color in each of the borders, for each color in each set of pockets, and for the various pockets throughout the stage. It does not pay to save cost on the stage switchboard.

The remarks relative to the switchboard apply to the dimmers.

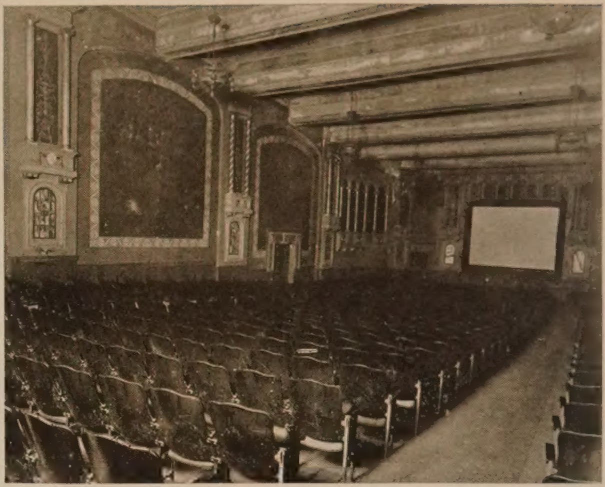
No house is now complete, whether it be for legitimate or intimate drama, musical comedy, or any other purpose, without a picture-booth. The utility of a room of this sort is fully recognized, and it is now used for spot and flood light purposes in houses that do not show moving pictures. Formerly the spotlight operator occupied what was perhaps the most valuable seating-room in the house, the front of the first balcony. Now, however, he is put in a booth, and does not disturb the patrons in any way by his presence.

The electrical equipment of the booth for legitimate houses should consist of a sufficient number of pockets of large capacity for spot and flood lights. In addition it should be provided with capacity for one to three picture-machines, even though they are not required when the theatre is opened. The value of making provision for these machines is apparent to any manager who is suddenly called upon for current in excess of that originally provided for.

The interior color scheme is a very important subject for the architect. This subject is



Arena Theatre, New York. S. B. Eisendrath, Architect. B. Horwitz, Associate.



Auditorium, Arena Theatre, New York. S. B. Eisendrath, Architect. B. Horwitz, Associate.

usually well handled, though some houses have been made too light in color, which is regretted.

The selection of draperies is important, as they must be a color that will permit the use of various lighting effects thereon. It is very interesting to note the careful handling of this item in our most recent theatres. The carpets should be a dark color and set preferably on a wood floor. This not only gives better chance for the fastening of same but gives a more satisfactory surface to fasten the chairs. This is not an essential, however, as good results have been obtained with a cement floor.

The structural problems confronted in theatre design are most difficult, and are items where considerable money can be saved in steel tonnage by having the services of a specialist on the subject. It is hoped that one of the many men capable will later provide the readers of ARCHITECTURE with an article on the subject, wherein the points most necessary for economical steel design will be stated.

Making Over the Old Theatre for the Movies

CONVERTING the average theatre building to motion-pictures is a matter of little trouble and comparatively small cost.

The projection-booth should be placed in the back top end of the balcony and, if possible, suspended from the ceiling construction under the gallery. With a booth thus suspended, there is generally no loss of seats. If the space between the balcony and gallery is not sufficient to permit projecting the pictures without interception by people in the balcony, the booth can be placed at the back top end of the gallery. It is much better, however, to project the picture from the balcony, even at the cost of a few seats, as the screen image is many times badly distorted by wide angle and throw necessary from the gallery.

The dimensions of the booth need not be more than 7 to 8 feet in height, 6 to 7 feet in construction, and although the law requires it to be fireproof, it can be of light construction. Metal lath plastered solid 2½ inches thick with Portland-cement plaster is best for the enclosing walls. The screen should be placed on the stage, hung from above. It can easily be removed—if a drop is not used—either by sliding to one side as with ordinary scenery, or it can be made in the form of a roller-shade and readily rolled up.

The necessary feed-wires for supplying machines and other equipment are easily installed. The feed-wires carried into every theatre building are of ample capacity to take care of all requirements, especially where the usual scenic lighting for regular theatrical purposes is dispensed with.

Aisles, exits, and outside courts required in using a theatre for the showing of pictures in most cases need no attention other than for handling the outgoing and incoming audiences between shows. Any legitimate theatre conforming to the building laws is equally satisfactory and adequate for picture purposes.

Where a theatre is to be used largely for motion-pictures, various decorative features can be added on either side and above the screen, as it is done in many permanent picture theatres in the larger cities. This is particularly desirable if it is intended to have musical or vaudeville acts between the pictures, as it affords a pleasing background during these intervals. These decorative effects involve no structural change. On the contrary, most stages are of ample size to install special landscape or architectural effects around the screen.

A Design for a National Memorial

Submitted by Armstrong & De Gelleke, Architects, to the Mayor's Committee, New York

IT is proposed to erect a memorial to the men who served in the Great War, as a national token of esteem for their valor and patriotism. We believe such a monument should be large in its idea, daring in its conception, simple in its architecture, and purely American.

It is to be 1,000 feet high, situated in Central Park, at the head of the lower reservoir, and the surrounding in which it is to be situated would lend itself to a huge garden effect, and would lay claim to being the highest edifice in existence. Its location would be central from all parts of Manhattan Island, and a large section of the Bronx district, and visible for many miles by day, or when illuminated at night.

The general scheme of the monument is a hexagonal obelisk, symbolizing immortality, and to be flanked on both sides by two Greek-like temples; these buildings to contain trophies and war records, and to be connected by a semicircular colonnade leading to the principal entrance of a large open-air amphitheatre and public recreation grounds, which would be in the basin or sunken area of the large upper reservoir. The semicircular space between the colonnade and the monument to be a garden or grove, enhanced by small sculptural groups, and planted with fine trees and flowering shrubs, which would create an atmosphere similar to the famous temple and sanctuary erected to Apollo in the Sacred Grove at Delphi, erected by the Greeks in the first century B. C.

We believe the advantages of its proposed location are many in that the city is to abandon these water-storage areas, and these areas of water, together with their retaining walls and terraces, would be available and adaptable for a rare landscape and architectural development, such as the Gardens of Versailles or the Royal Italian Palace at Casertta. These sunken levels would lend themselves to such a treatment at comparatively small cost, and with this thought in view we have designed the monument as a start or nucleus of the suggested development. The illustration on page 234 shows the monument at the head or narrow end of a long pool and sunken garden, and would be an excellent setting for such a monument, as it would give a reflection that would mirror the changes of color and sky throughout the day.

The main monument is to be supported on its diagonal faces at the base by four smaller engaged obelisks, each to be a monument in itself to the four arms of the service, namely: the army, the navy, the marines, and aviation. The faces of these obelisks are to have sculptured ornaments of trophies of the particular service, together with tables at various heights, bearing the names of battles or campaigns in which the particular arm served with distinction. The obelisks are to be capped by gilded frustrums which would reflect the first rays of the morning sun and the last rays of the setting sun.

Over the central entrance, which faces south, there is to be a large group of figures representing the city or State of New York, and above this group is the Dedication Tablet in sculpture, flanked by two huge figures in bas-relief symbolizing Patriotism and Courage. The principal entrance admits to a huge central domed hall, whose walls are to contain inserted bronze or marble tablets recording the part played by any city, town, county, or State in the erection of this monument. This central hall would contain a bank of elevators to take the visitor to the observation-room at the top of the monument; also from this central hall would start an inclined ramp, or walk, to the top, with various landings to give interesting views.

In a chamber above the observation-room it is proposed to establish a permanent wireless-collecting station that might at some time serve the country in the same priceless way that the Eiffel Tower served France during the Great War.

The monument itself would be purely American in its symbolism and construction. The American contribution to the world architecturally has been the sky-scraper office-building, and in the constructive field the steel shell. Both of these would be incorporated in the monument, which would be built with a steel framework, veneered with white marble. Its cost would not equal that of any steel-constructed office-building, but, on the other hand, would be less because of the absence of interior furnishings.

Book Review

"OLD CROSSES AND LYCH-GATES." By AYMER VALLANCE. London: B. T. Batsford; New York: Charles Scribner's Sons. With over 200 illustrations from photographs, rare old prints, and original drawings.

Even a casual turning of the pages of this interesting book brings into one's thoughts the admirable and appropriate material it offers for moderate cost memorials to our soldiers. There are abundant and beautiful examples of these old monuments found in England and Wales upon which might be based especially suitable memorials for small communities. This applies particularly to the crosses, of which a great variety of form and design are shown. Many of them could be built of the local stone available in nearly every section of the country, and they could be simple or elaborate with suitable tablets either engraved in the stone or applied by means of a bronze tablet.

"In older times these crosses were the centre for various celebrations. At Chester the High Cross was the scene of all great civic functions. Here again royalty was received, here proclamations were read with due formality. They were a recognized place for public proclamations."

No one who has visited the smaller English towns off the beaten track will have failed to carry away some remembrance of an old cross or lych-gate connected with a picturesque little English church.

There is a fund of suggestion in the many illustrations from both photographs and drawings.

Most of us know both the stone soldiers and the more or less plain or decorated shafts put up as memorials to our Civil War veterans, and we all know how bad they are with very few exceptions.

The author's text traces the origin of these crosses back to the menhir, and describes many of the best-known types of the developed crosses in England and Wales.

The lych-gate was so called (the word *lich* meaning corpse) because it stood at the entrance of the churchyard, a place where the bearers might rest their burden on the way into the church. Many of them had screens built over them.

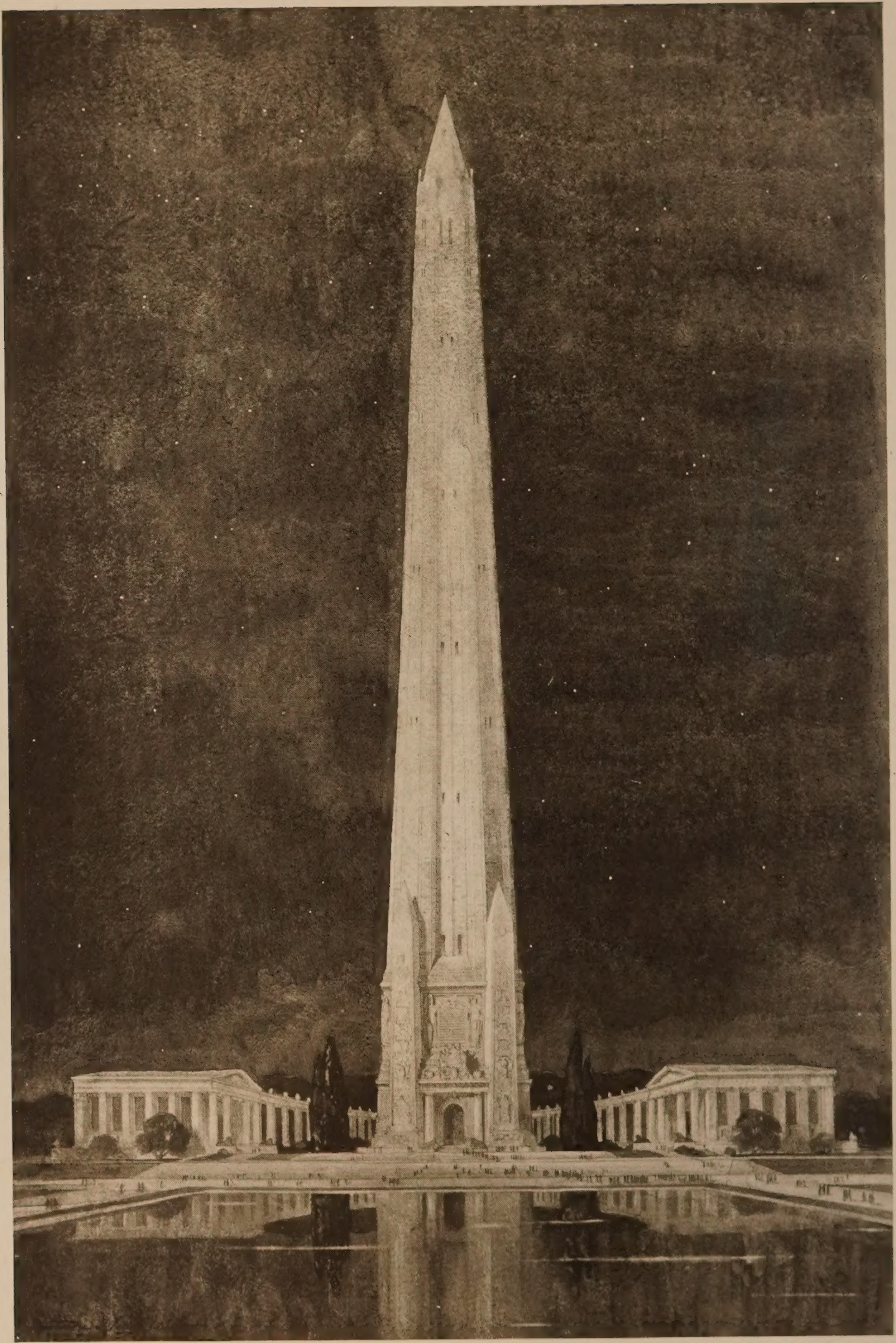
TO THE EDITOR OF ARCHITECTURE:

Dear Sir: The secretary of the American Institute of Architects has called my attention to an inaccurate statement made in my article, "An Accounting System for an Architect's Office," published in the April issue of ARCHITECTURE.

In the third paragraph of the article I stated: "The American Institute of Architects has established a schedule of fees to which we are obliged to strictly adhere."

This statement is in error. I should have said that the Institute has laid down a schedule of reasonable minimum charges which it is customary to employ under certain standard conditions. From a careful reading of the Institute's schedule of proper minimum charges, it is quite clear that the fees established are in no way mandatory.

Very truly yours,
H. P. VAN ARSDALL.



DESIGN FOR NATIONAL MEMORIAL. (From a rendering by W. T. L. Armstrong.) Armstrong & De Gelleke, Architects.
Submitted to Mayor's Committee, New York.

Editorial and Other Comment

The Architects of St. Thomas's—A Correction

IN his article in the July number of ARCHITECTURE on "St. Thomas's and Its Reredos" Mr. Peixotto quite inadvertently, in his statement that "the church as we see it to-day is essentally Mr. Goodhue's," did an injustice to the other members of the firm who were equally associated in its design. The church was the result of the co-operation between all the members of the firm of Cram, Goodhue & Ferguson, and credit for its great success and distinction should have been given alike to all three members of the firm. Mr. Goodhue personally asks us to state that the paragraph in question did "distinctly more than justice to me, and does very grave injustice to both my former partners."

Theatres

AS a sign of the times, an expression of the mood of a people, the taste of a public, there is nothing more significant than the multiplicity of theatres, large and small, that are going up all over the country. Hardly a small town now but has its playhouse, usually devoted to the movies, and that they are proving a profitable investment is evidenced by the fact that more than any other kind of building they seem easily financed. The movies have driven out plays from many famous old houses that were once the homes of the legitimate; and the largest of the new houses are given over to the movies, either with or without accompanying vaudeville or some musical entertainment. In New York there are more than 650 theatres in the greater city, and more are under construction. The amount of money already appropriated for new amusement houses in New York alone amounts, we are informed, to something like $25,000,000.

The architecture of the theatre seems to be very much specialized, and the problems involved call for trained experts in this particular field. The plans vary with the needs of particular localities and purposes, but the fundamental consideration seems the using of spaces to permit of the largest unobstructed seating capacity and the easy inflow and exit of changing audiences, combined with requirements of safety. We have had requests from various quarters asking for a number of ARCHITECTURE in which might be shown some typical theatres of to-day, and our readers will find shown herein types that have the authority of architects trained in this special field, together with Mr. Mlinar's admirable discussion of the practical questions involved.

One of the great contributing factors in theatre construction of to-day is the use of reinforced-concrete arches. Some of the spaces covered in this way are amazing in their daring and knowledge of the engineering problems involved.

In no other country in the world has the theatre become such an essential part, such an intimate part, of the lives of millions. One of the recent tendencies is in the combining of the theatre with a great modern office or studio building, and the economic value of such a combination seems too obvious to need emphasis.

There is too often much to be desired in the decoration of many of our playhouses, and there seems no reason why we should not have less of the garish and overloaded ornament so prevalent and more quietly appropriate ornament based upon either some frankly studied period style, or, if we must be modern, governed more by good taste than the mere desire to express the fact of unlimited expenditure.

Now and then we come upon some small provincial theatre devoted to the movies that is delightfully restful by its very absence of the customary stock-theatre decorative properties.

Some Comment on the Competition for the Nebraska State Capitol

WE were much interested in the comment and discussion of the question of the selection of the architect for the Nebraska State Capitol by a writer in the New York *Evening Post*. There are some points so well taken that we feel warranted in quoting this extract that may find a responsive attitude in the minds of many of our readers. The whole question of competition has been, and will be always, a moot question.

The Nebraska way, at least, had the great merit of avoiding some of the most objectionable features of old methods. As the *Post* says:

"The programme made three radical departures from precedent. No predetermined concept was disclosed; the competitors were left as much as possible in the dark as to the kind of building wanted. No jury was selected to judge the designs until after the designs had been submitted. No limits, beyond ordinary considerations of reasonableness, were set in the matter of cubage and cost.

"That direct selection of the architect has been approximated by these innovations is plain enough. Not a solution but ability to solve, not a design for use but a demonstration of power, not the plan but the man was the goal. The obtaining of a design was as far as possible eliminated from the test.

"What would be lost in eliminating it altogether? What is gained by retaining the competition at all? The programme, for all its breadth of vision, is hazy as to these implied questions. If a public demonstration is needed of the superiority of leaders and the inferiority of inadequate talents and experience, a competition under almost any plan will yield the object-lesson. The old dilemma meanwhile persists: the competition is a faulty method of obtaining solutions and the solution is the only truly adjusted function which a competition has. So far as the Nebraska plan devolves upon the jury a selection among ten designated architects on the basis of their ten solutions of a vaguely defined problem, the jury being cautioned not to rely too much on the solutions themselves, it may seem to be moving to improve the architectural competition out of existence. A few more steps in this direction and we may find the architect selected as other professional servants are selected—on the tangible evidence of past performances."

As to Advertising

OUR attention was attracted recently by an attractive city alteration, and our eyes focussed upon, among other things, two signs announcing the names of the builders and those of the architects. We couldn't help feeling that there was no sufficient reason why the architects shouldn't make themselves known to the man on the street, or see any lack of professional dignity in the fact. Of course there are certain reservations in the conduct of all professional men, a code of ethics, a gentleman's agreement to play fair and not bring contumely upon one's calling, but even gentlemen may announce themselves in gentlemanly terms and in the good taste that most men worthy of the name of architect would likely prefer.

The big men of any profession are quickly known by their works, but the man with a reputation yet to make finds it mighty hard in these competitive days to just sit tight and trust in Providence to be discovered. In an upstate newspaper we saw a large display advertisement of a local firm of architects, and now that the Institute has modified its rules, maybe we shall see more architects doing as other business men do who seek the public interest and declare themselves ready and qualified to accept commissions from all who offer.

Of Especially Timely Interest

ARCHITECTURE will begin in the September number a series of articles of great practical value to every member of the profession. They will be written by H. Vandervoort Walsh, instructor in Architecture, Columbia University School of Architecture, and will deal with

"The Construction of the Small House"

Articles already arranged for, each one of which will include illustrations, are:

I. Present-Day Economic Troubles.
II. General Types and Costs.
III. Essential Standards of Quality in Building-Materials.
IV. Construction of the Masonry-and-Wood Dwelling.

Others will be announced later.

Teaching Architecture by Practical Methods

NEW methods of teaching, designed to remove "the malicious influence" which pure paper has upon the imagination of the student and to avoid mistakes which would stand as glaring faults through many generations, are now being employed in the School of Architecture of Columbia University.

The student is no longer restricted to one dimensional architecture, portrayed wholly on paper, but is required to construct models which bring into play the same skill and perspective demanded in the actual practice of the architectural profession. Model-making as a means for construction in architecture is a long step in advance, according to the Columbia authorities, who also say that the war has changed American standards of art.

"It has long been appreciated that the student of architecture is trained largely in feeling for one dimensional architecture, presented entirely upon paper, and in the form of a plain elevation drawing," H. Vandervoort Walsh, of the Columbia teaching staff, said in describing the system of model-making now used to train Columbia architects.

"The student never has the opportunity which the practising architect finds of observing his design completed in all three dimensions. This privilege only belongs to the architect who has secured his commission and has had his building erected at the expense of his client. Many such architects have been astonished and surprised at mistakes in their design, due to the inability of drawings to fully represent the truth as it would appear in three dimensions. When the building is completed he has no opportunity of changing the form, and his mistake must stand as a glaring fault through many generations.

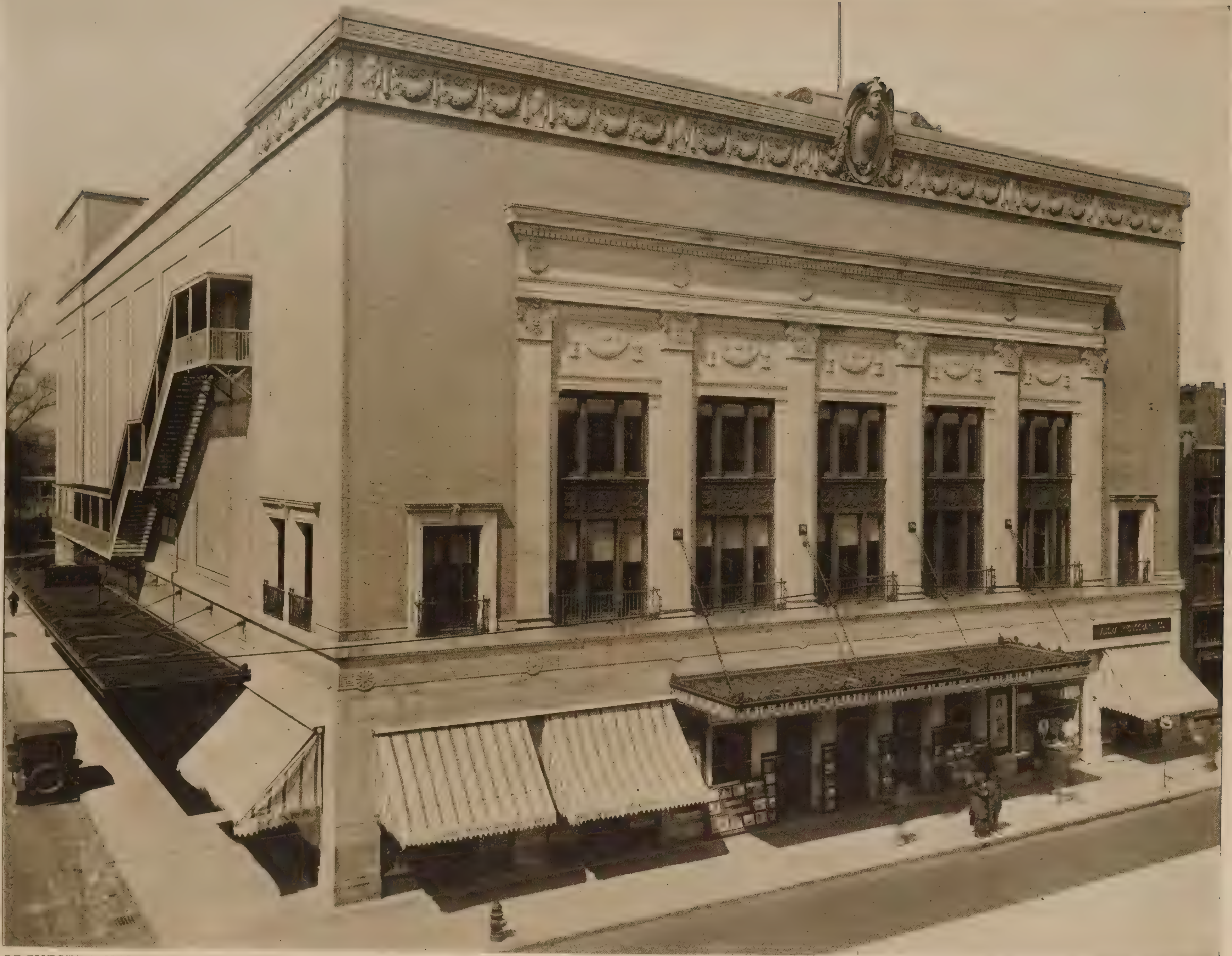
"The student of architecture who has the opportunity of designing a building, or a group of buildings, first on paper and then completing the same in the form of a model, has all the opportunities of observing the mistakes of his design without the cost of erecting the building. Moreover, he has removed the malicious influence which pure paper design has upon his imagination.

"Many a designer who has unusual skill in drawing and rendering, and who is blessed with an extremely fertile imagination, is often able to mislead himself with his pictures, and regard the thing he has erected on paper as beautiful architecture, while if it were constructed in three dimensions, in the form of a model, it would appear entirely absurd and ridiculous.

"The manner in which model-making is carried on in the School of Architecture in Columbia University is extremely simple. A squad of students is given a problem, as say, 'A Club Colony in Florida.' Each member of the squad then tries to solve this problem on paper according to his own ideas. These sketches are then judged by a jury consisting of the critics in design, and the best design is selected for the model. The students are then assigned to various parts of the model, some to making the landscape, others this building and others that building of the group.

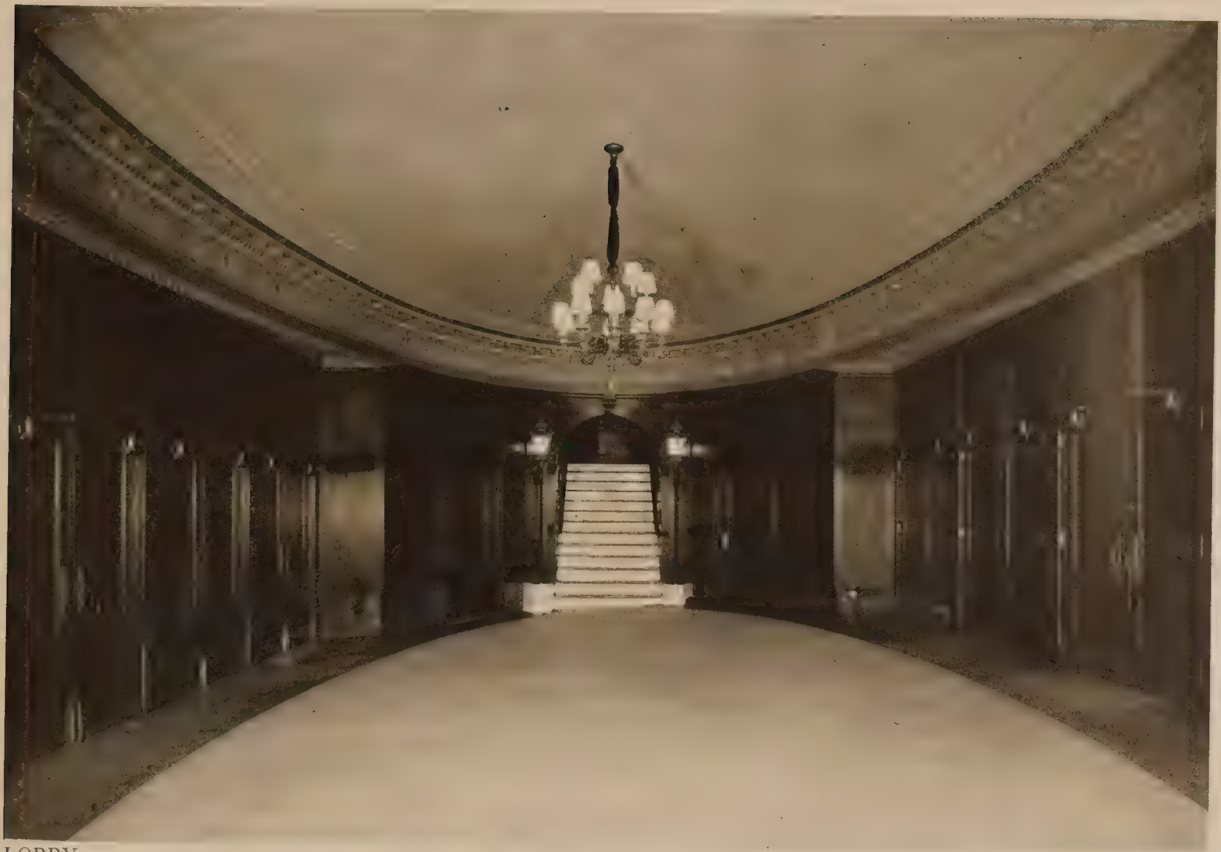
"The models of the buildings are constructed entirely of heavy illustration board. All elevations are drawn upon it, and minor projections, mouldings, windows, doors, and ornamental features of this type are rendered not in the usual architectural manner, but with a very hard, contrasting technic, so that these features will stand out strongly and realistically in the completed model. Large projecting members like cornices, columns, chimneys and dormers, etc., are made from anything that the student may be clever enough to use.

"In fact, the ingenuity displayed in the construction of a model is one of the fascinating features of the work. As for landscape gardening, grass made from stained sawdust, trees made from sponges, colonnades made from toothpicks, water-falls and fountains made from glass are a few suggestive ideas of the possibilities in these models."

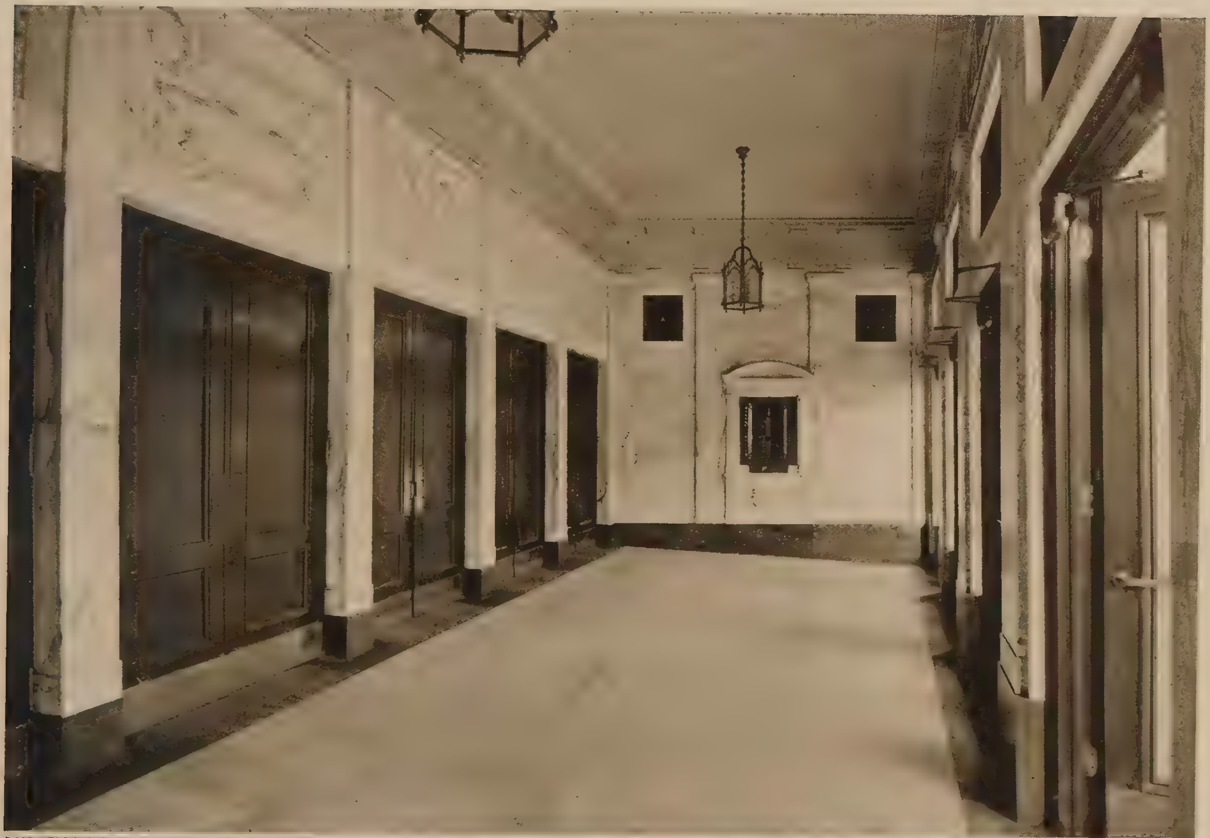


ORCHESTRA HALL, DETROIT, MICH.

C. Howard Crane, Architect. Elmer George Kiehler, Associate. Cyril E. Schley.



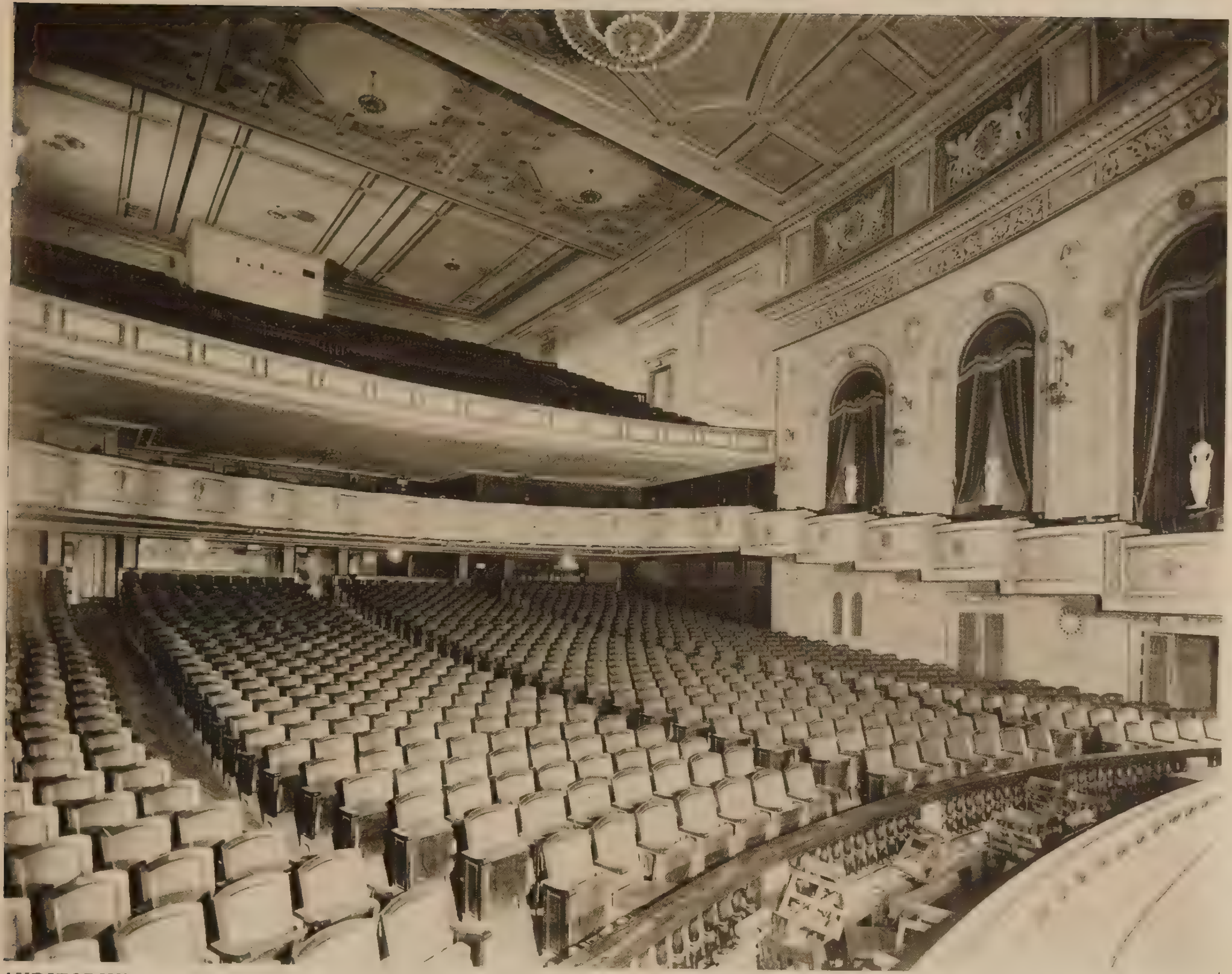
LOBBY.



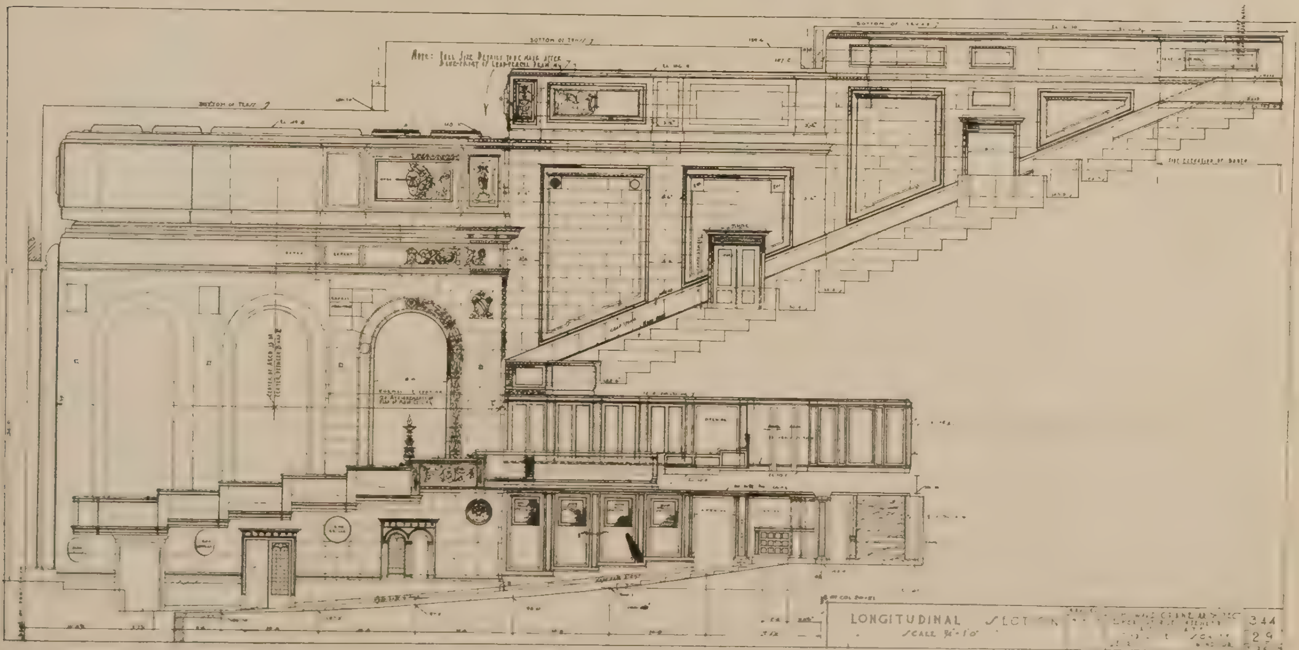
VESTIBULE.

C. Howard Crane, Architect. Elmer George Kiehler, Associate. Cyril E. Schley.

ORCHESTRA HALL, DETROIT, MICH.

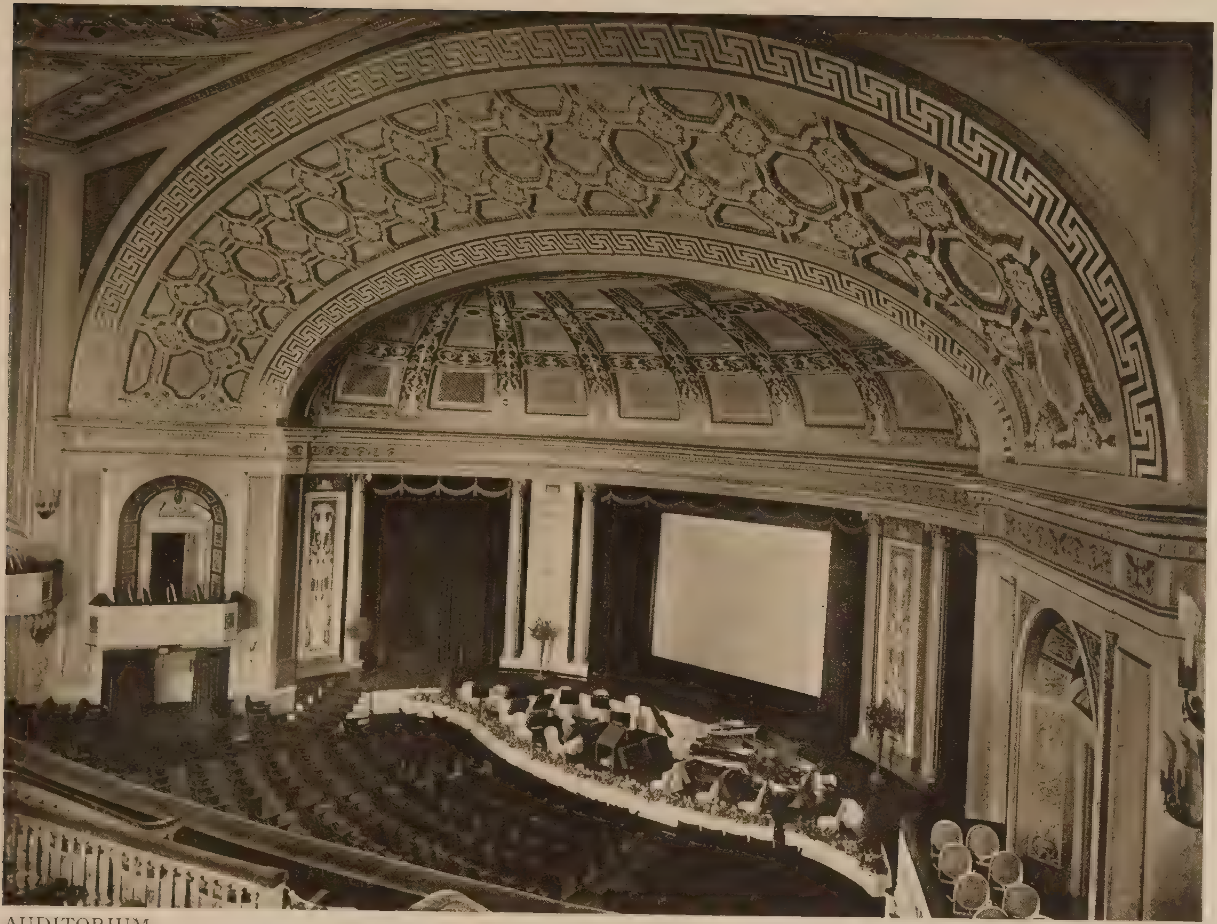


AUDITORIUM.


BOTTOM OF TRUSS
NOTE: FULL SIZE DETAILS TO BE MADE AFTER BLUE-PRINT OF LEAD-PENCIL DRAWING
LONGITUDINAL SECTION
SCALE ¼"=1'0"
344
29

LONGITUDINAL SECTION.

ORCHESTRA HALL, DETROIT, MICH.



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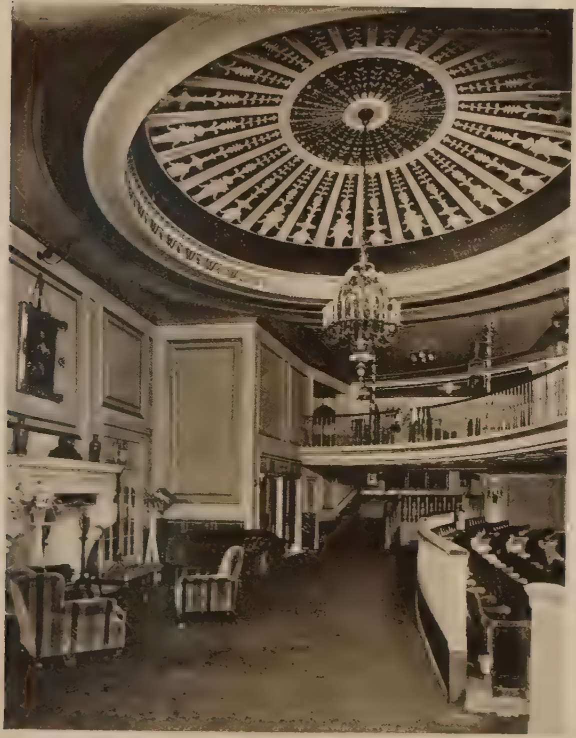
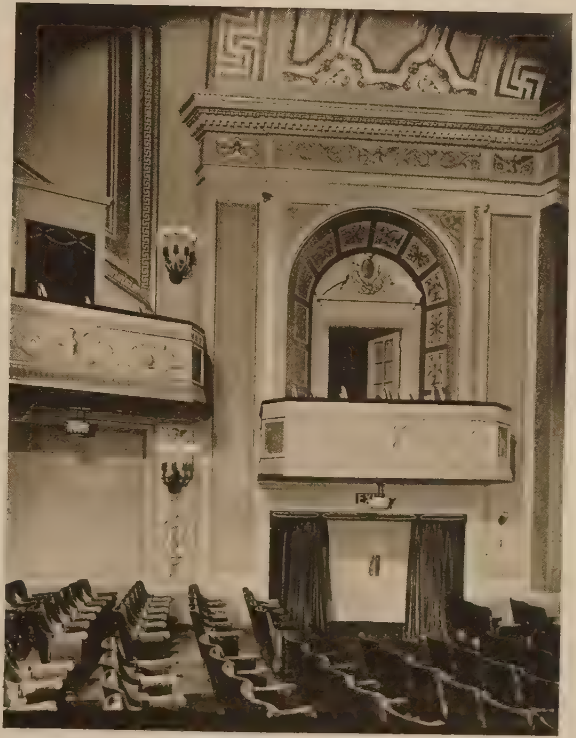
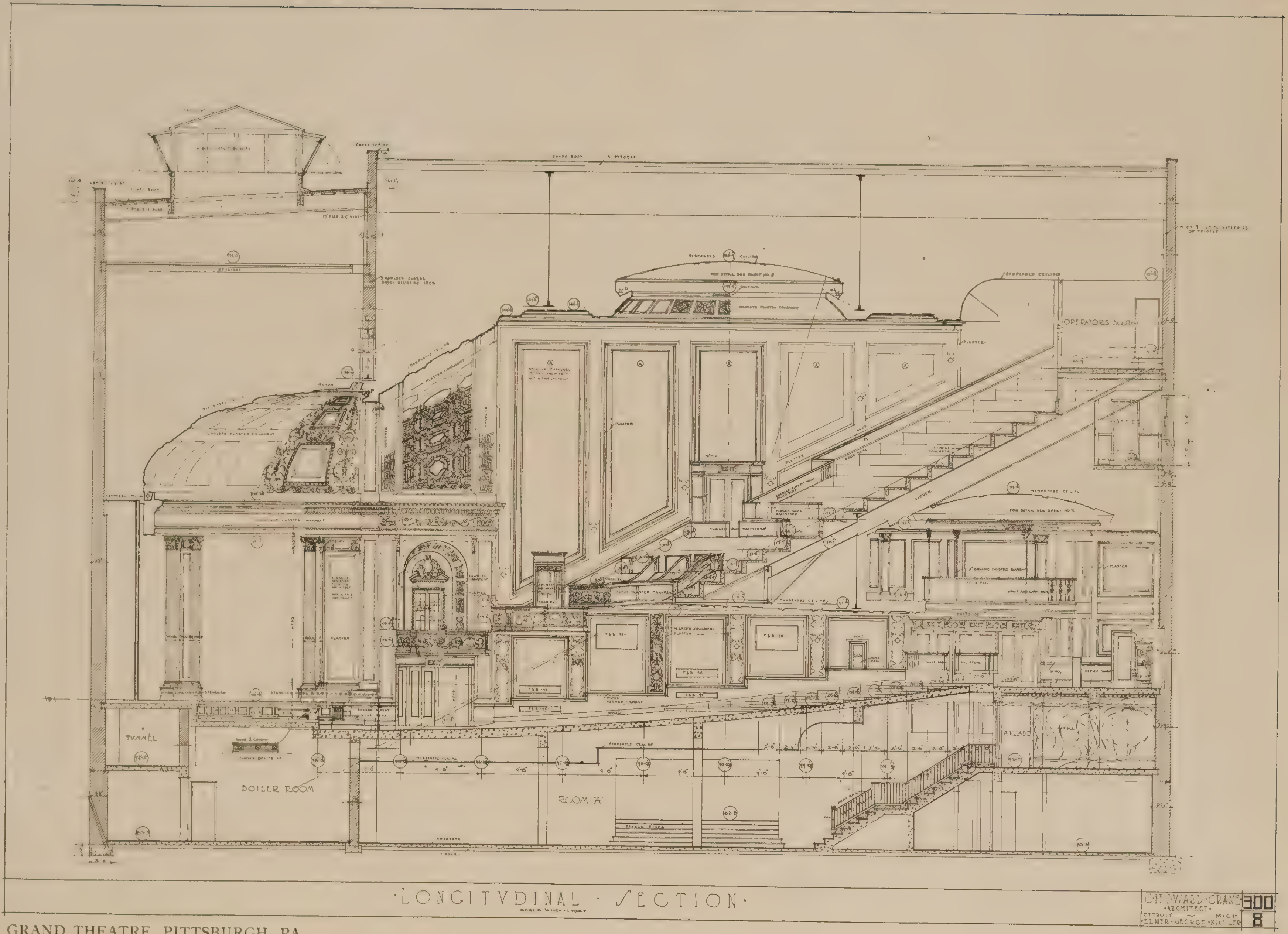


FOYER, FIRST FLOOR.

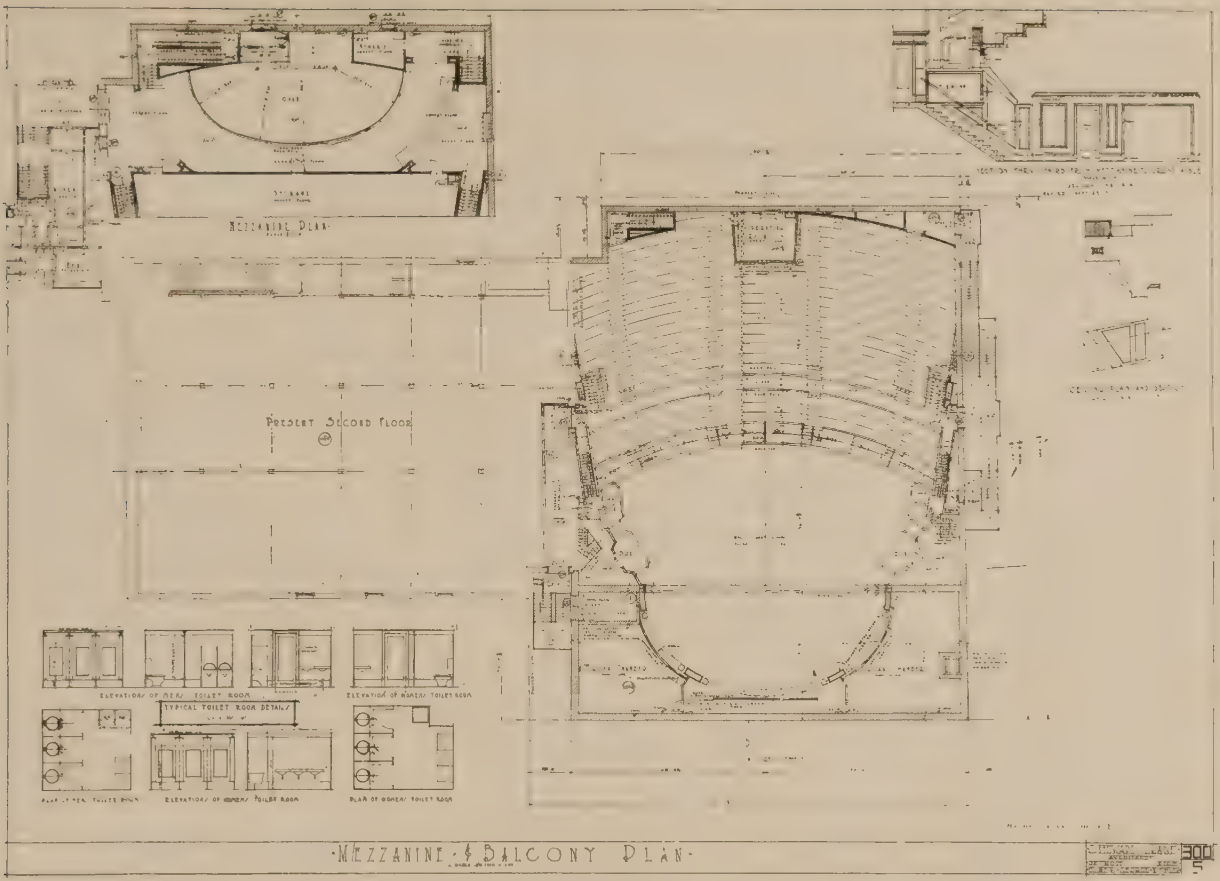


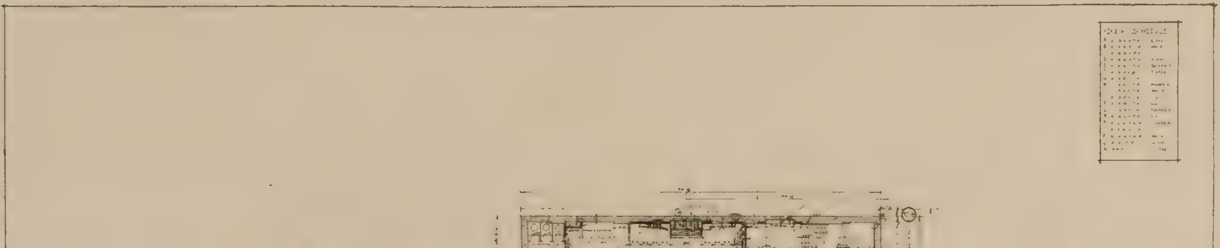
DETAIL OF BOX.

THE GRAND THEATRE, PITTSBURGH, PA.
C. Howard Crane, Architect. Elmer George Kiehler, Associate.

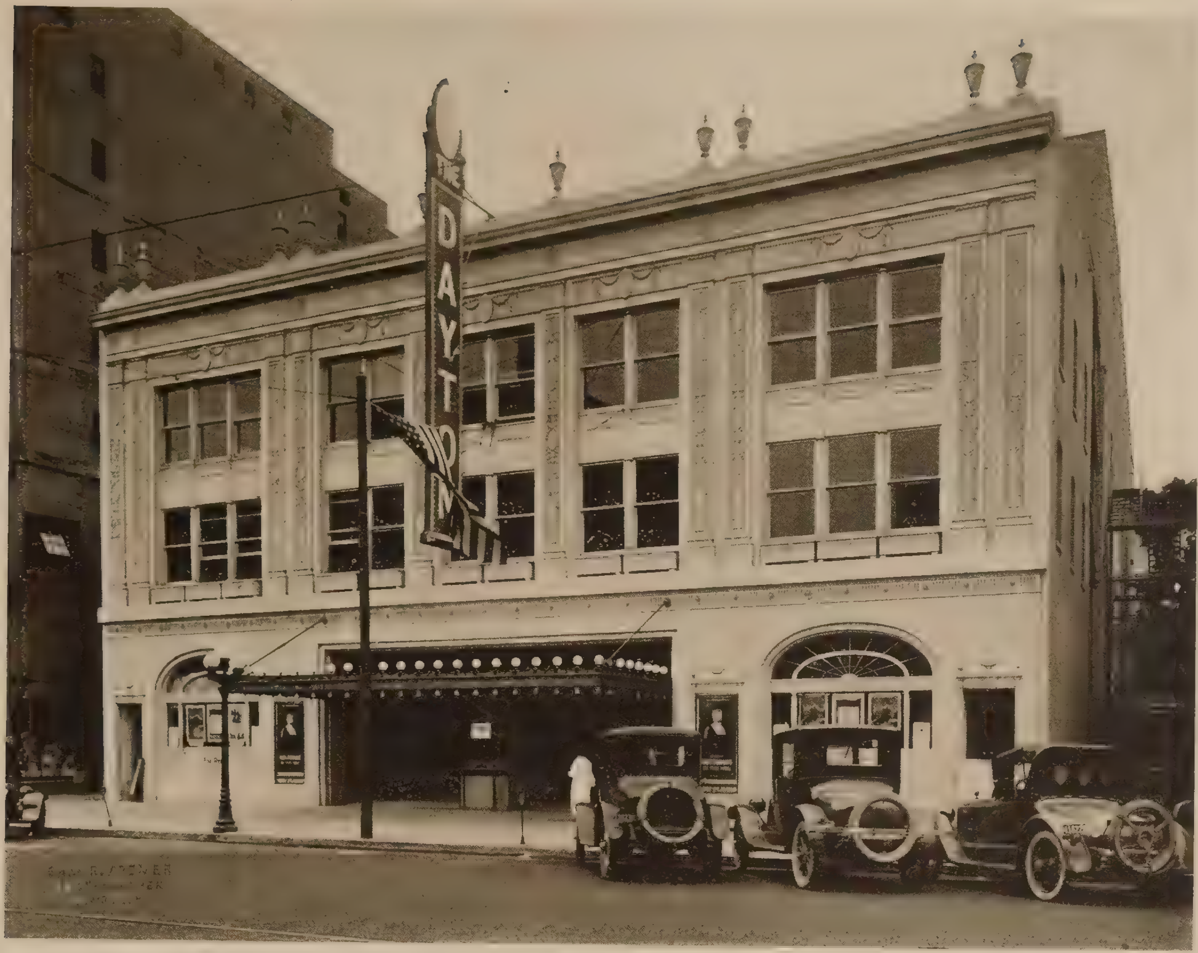


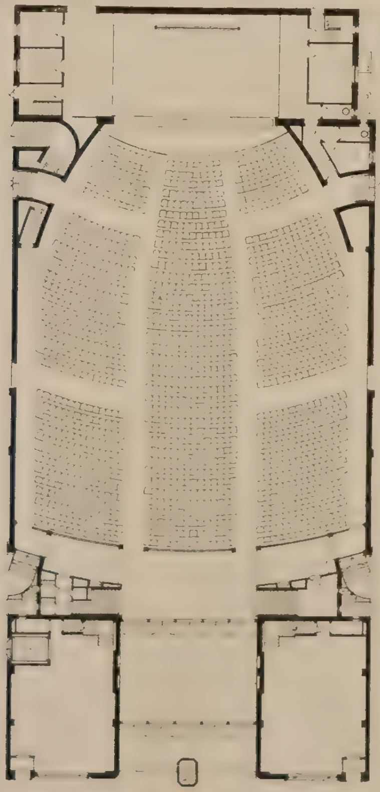
GRAND THEATRE, PITTSBURGH, PA.

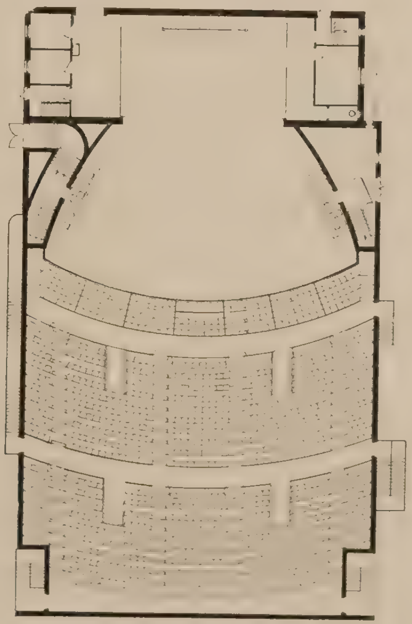

Mezzanine Plan
Present Second Floor
Elevations of Men's Toilet Room
Typical Toilet Room Details
Elevation of Women's Toilet Room
Elevations of Women's Toilet Room
Plan of Women's Toilet Room
·MEZZANINE·&·BALCONY PLAN·
300
5



GRAND THEATRE, PITTSBURGH, PA.

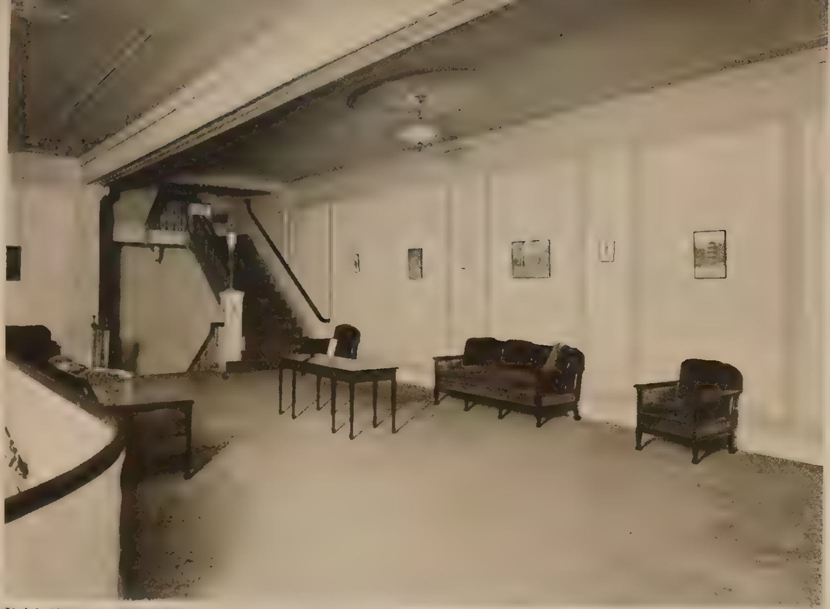




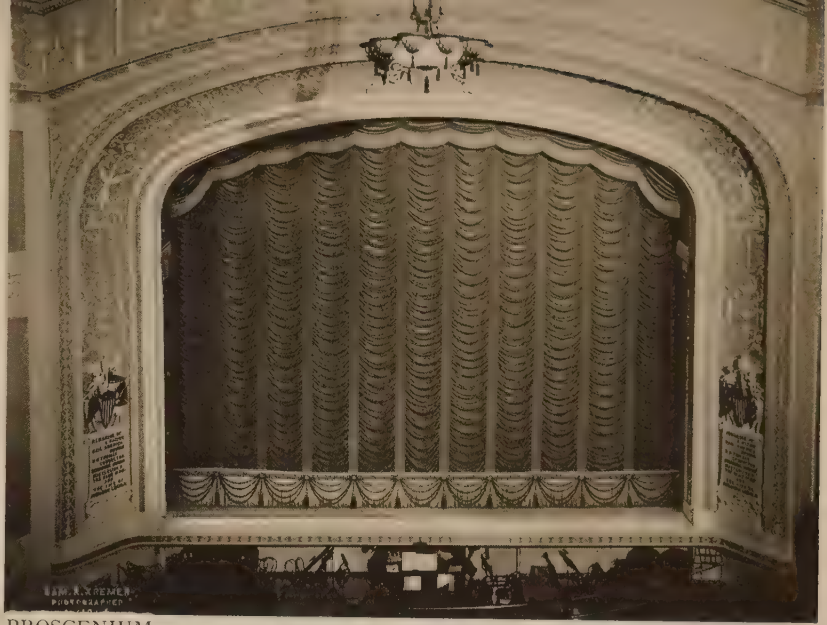


THE DAYTON THEATRE, DAYTON, OHIO.

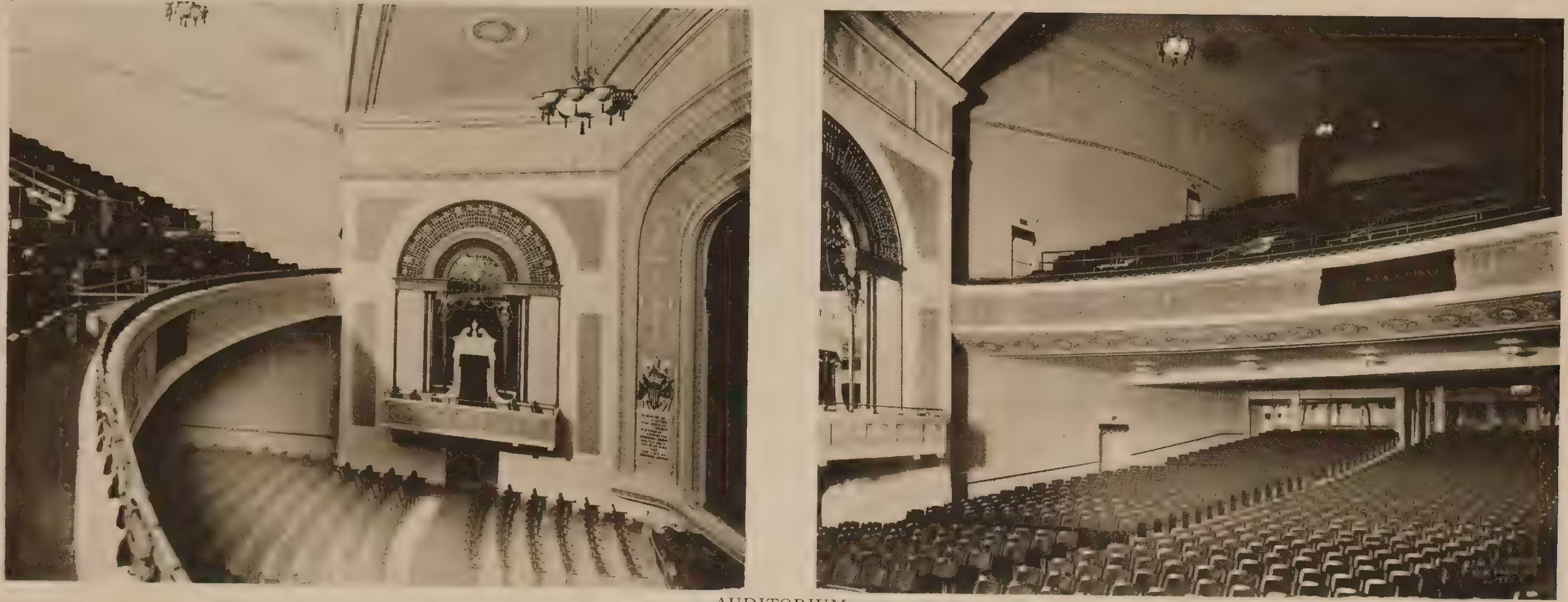
Schenck & Williams, Architects.



BALCONY FOYER.



PROSCENIUM.

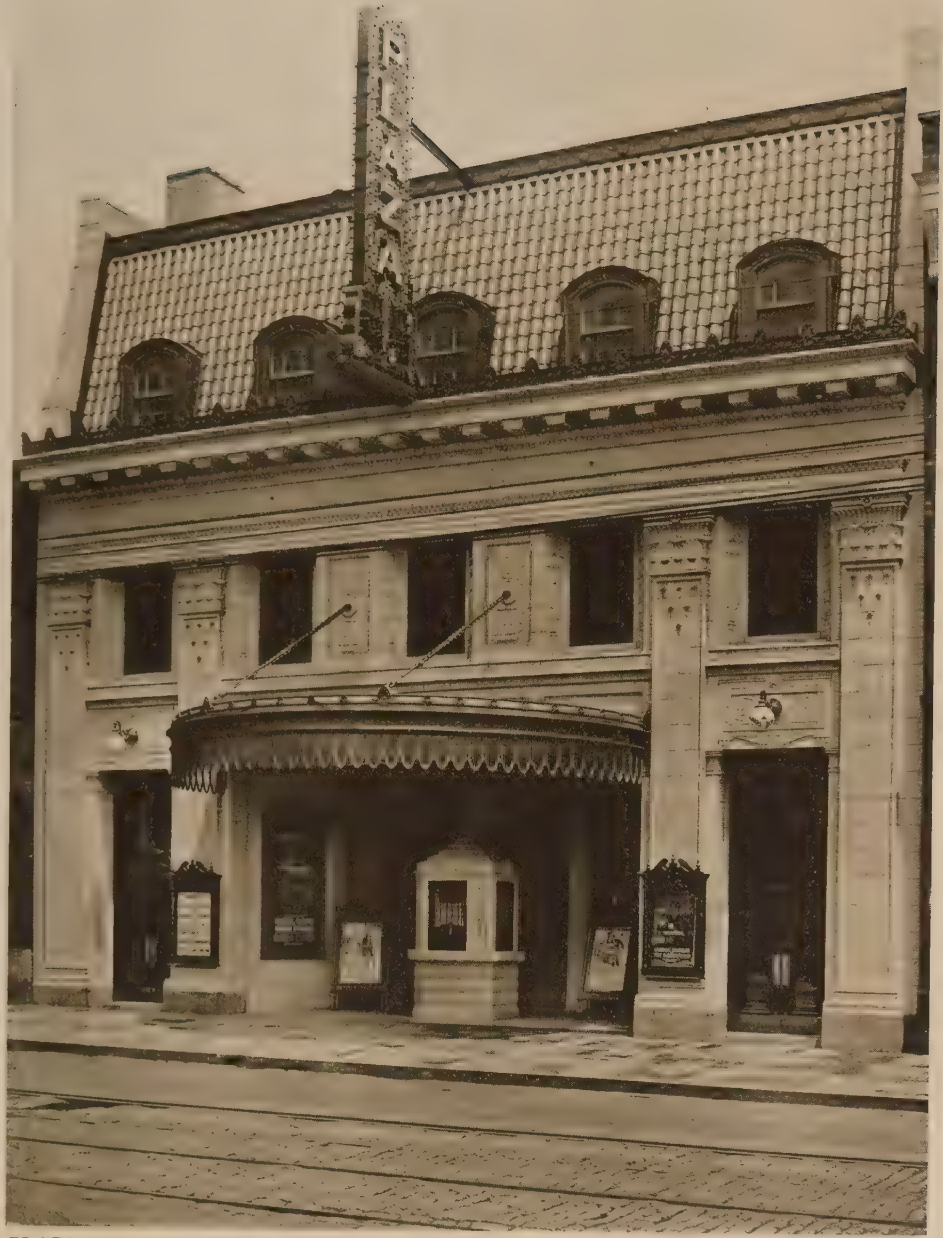


AUDITORIUM.

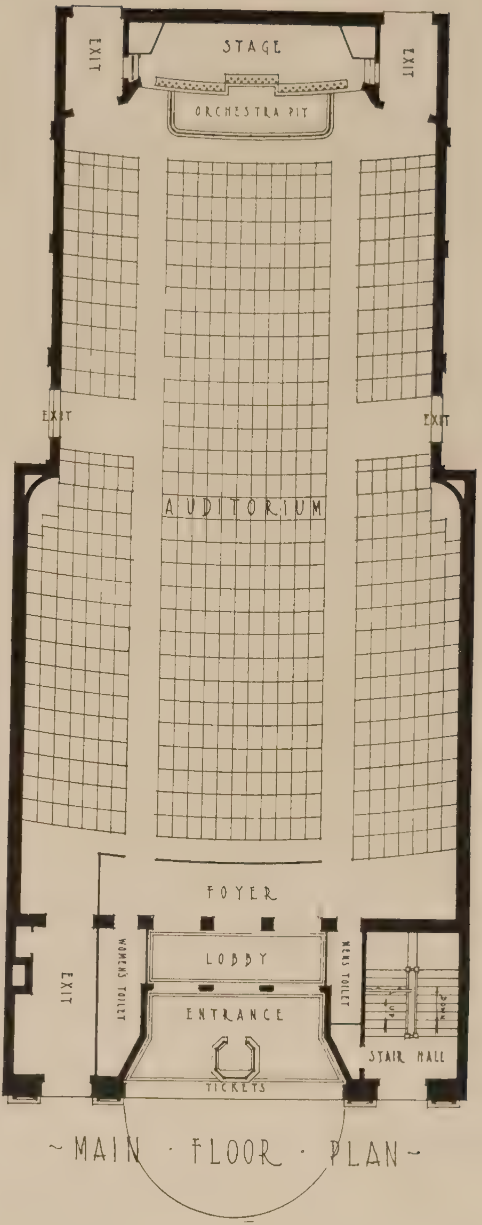
Schenck & Williams, Architects.

THE DAYTON THEATRE, DAYTON, OHIO.

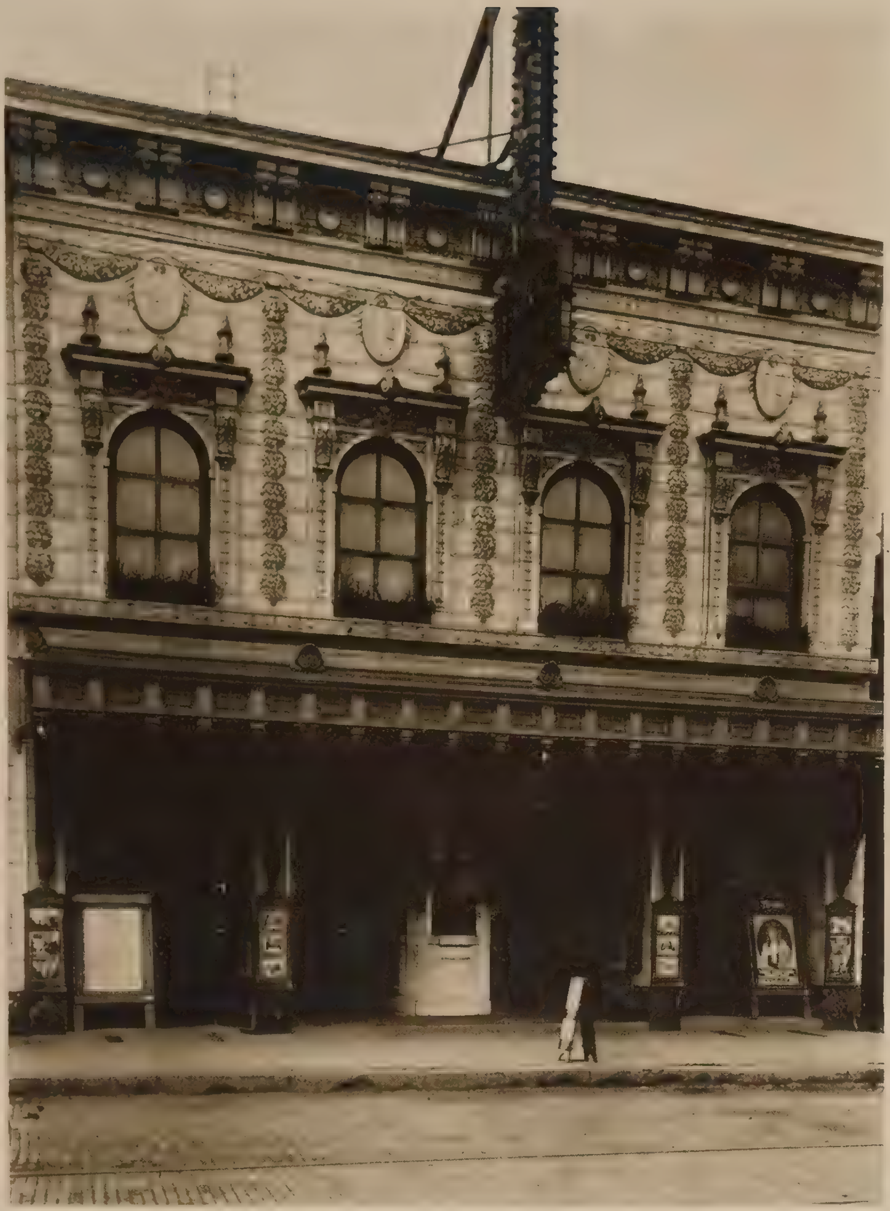
The seating capacity of the house is 2,300. One of the distinctive features is the fact that the projection booth occupies a place in the front of the balcony, but is so placed that the only seats which it displaces are about a half dozen seats in the front row of the balcony. This arrangement makes a very superior projection of the pictures, the projection machine being not over seventy feet from the screen and almost horizontal in its throw. Also, there is no noise whatever from the projection machine conveyed to the patrons either in the ground floor or balcony.



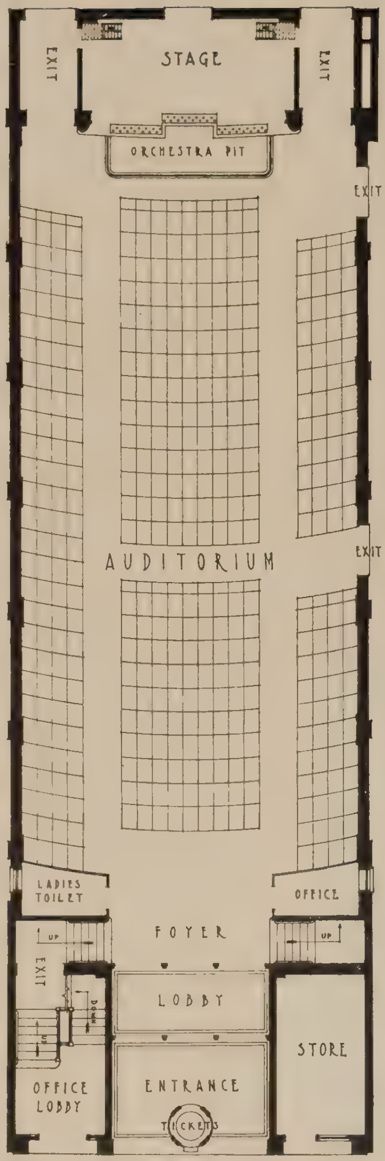
PLAZA THEATRE, PITTSBURGH, PA.



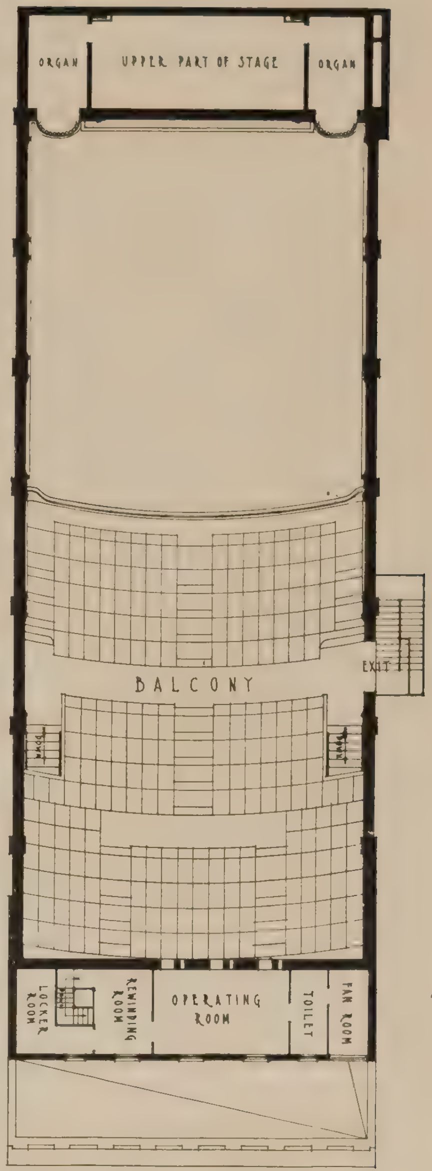
Harry S. Bair, Architect.



FREDERICK THEATRE, PITTSBURGH, PA.

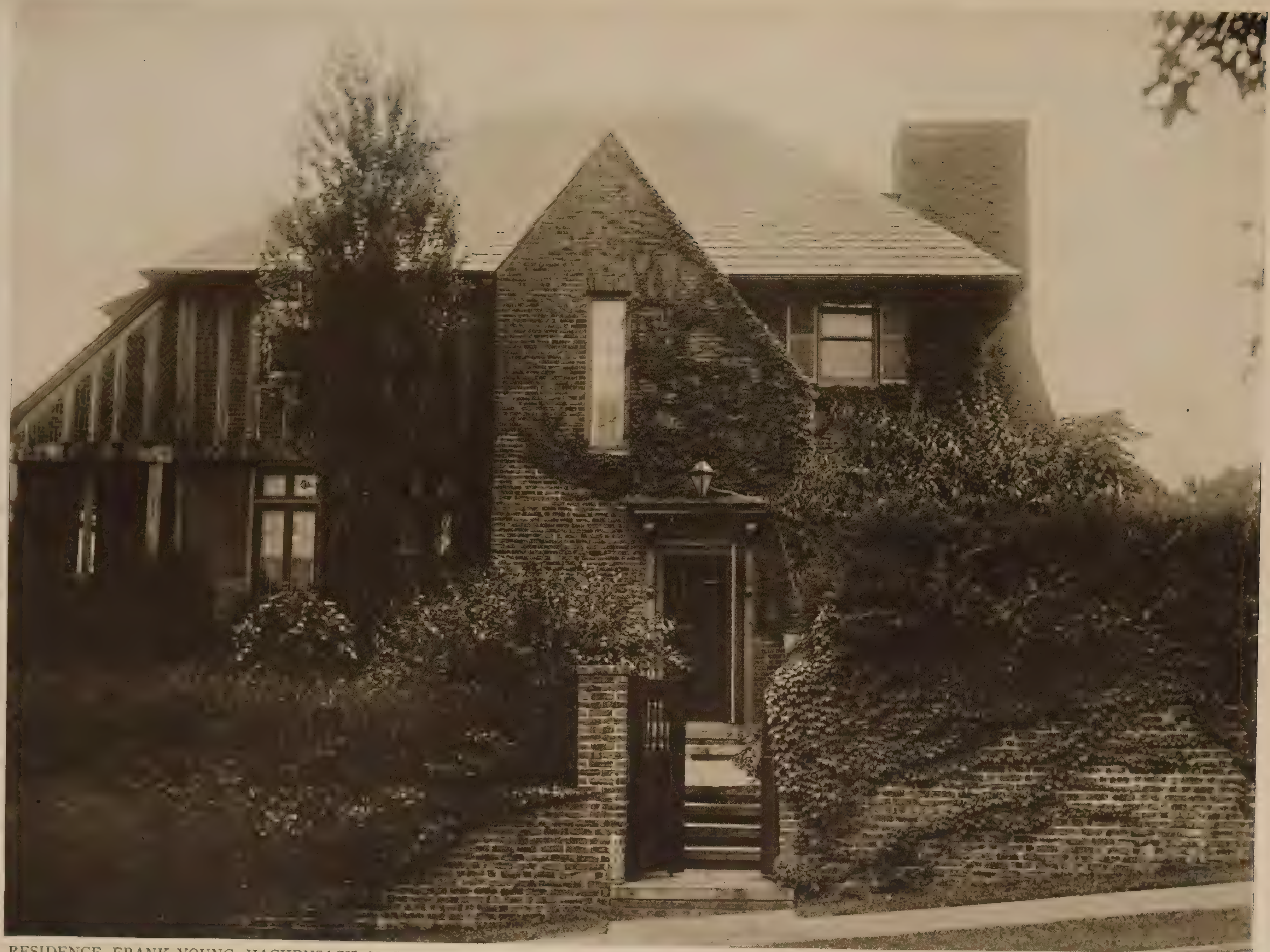


MAIN · FLOOR · PLAN



BALCONY · FLOOR · PLAN

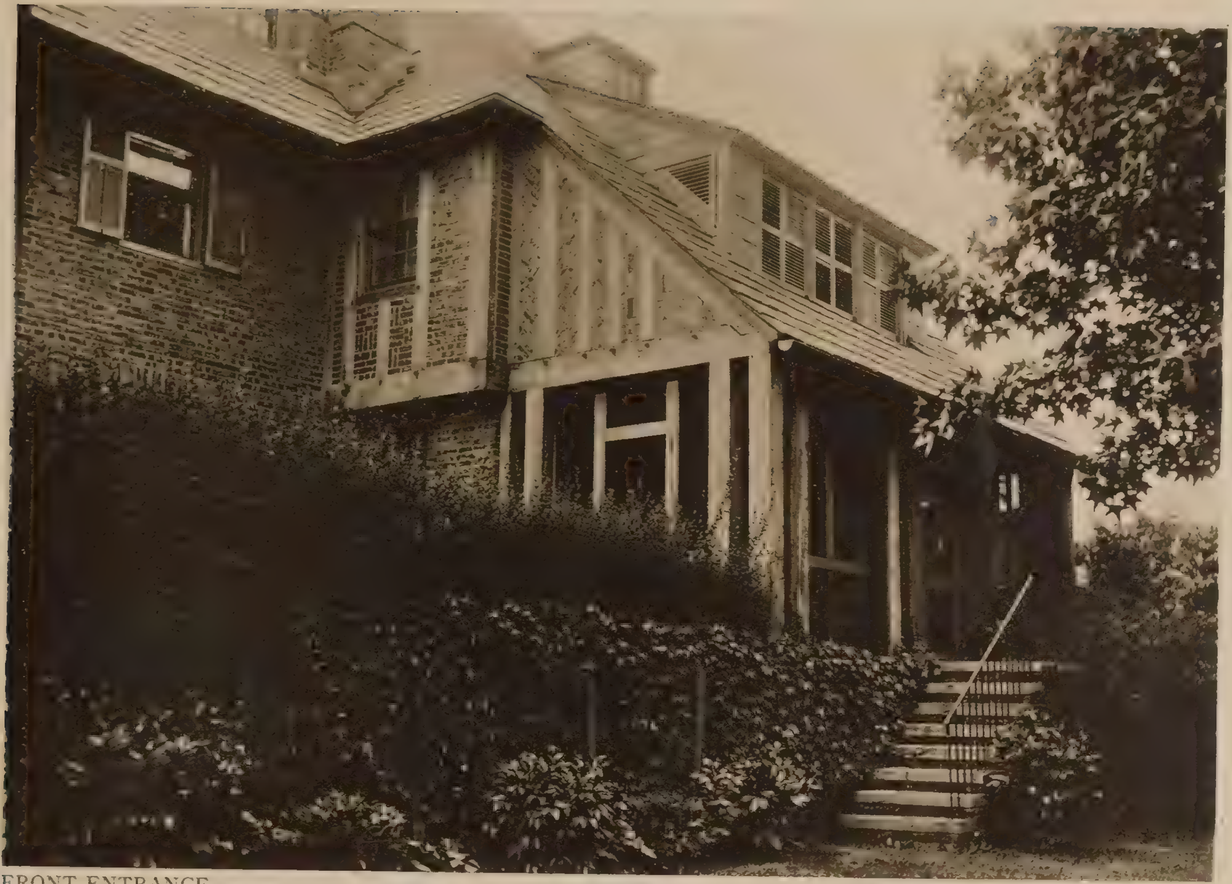
Harry S. Bair, Architect.



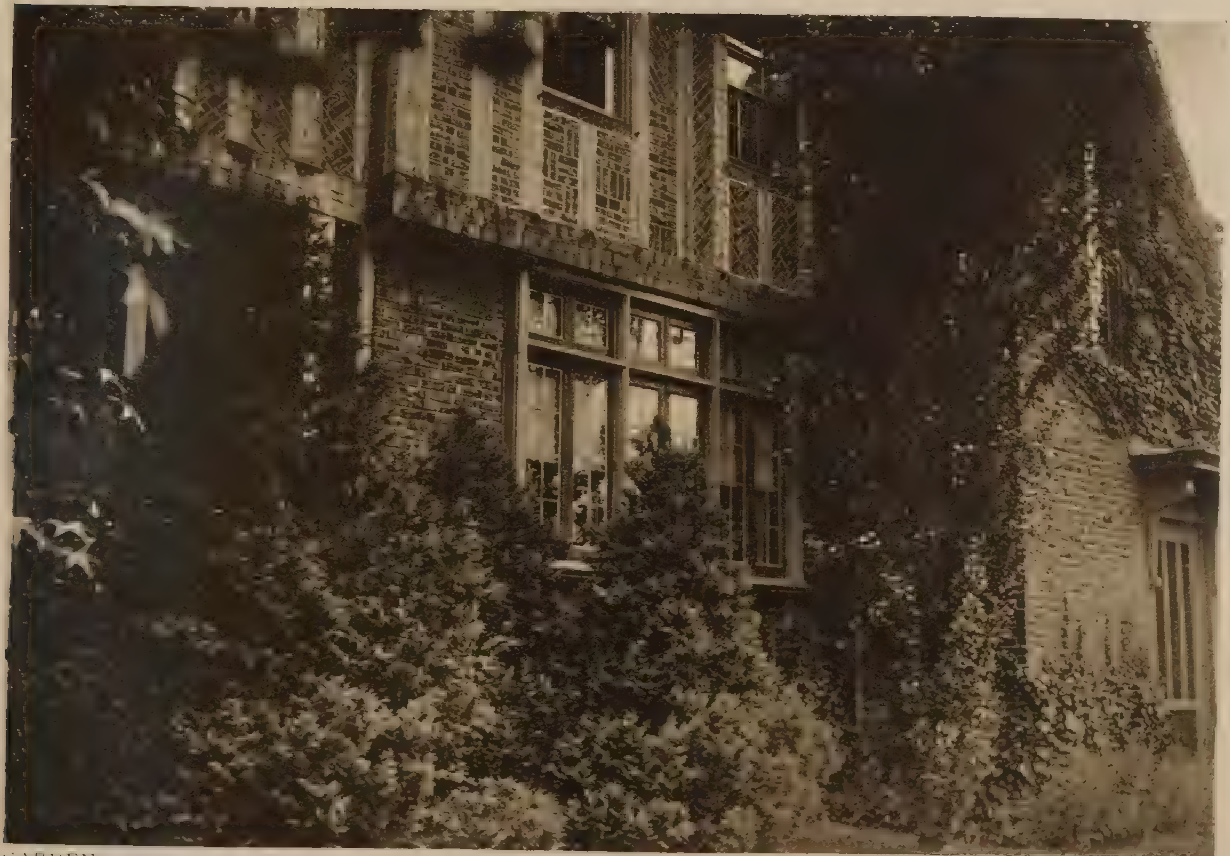
RESIDENCE, FRANK YOUNG, HACKENSACK, N. J.

Wesley Sherwood Bessell, Architect.

Winner of the First Prize in the New York *Tribune* Suburban Homes Contest.



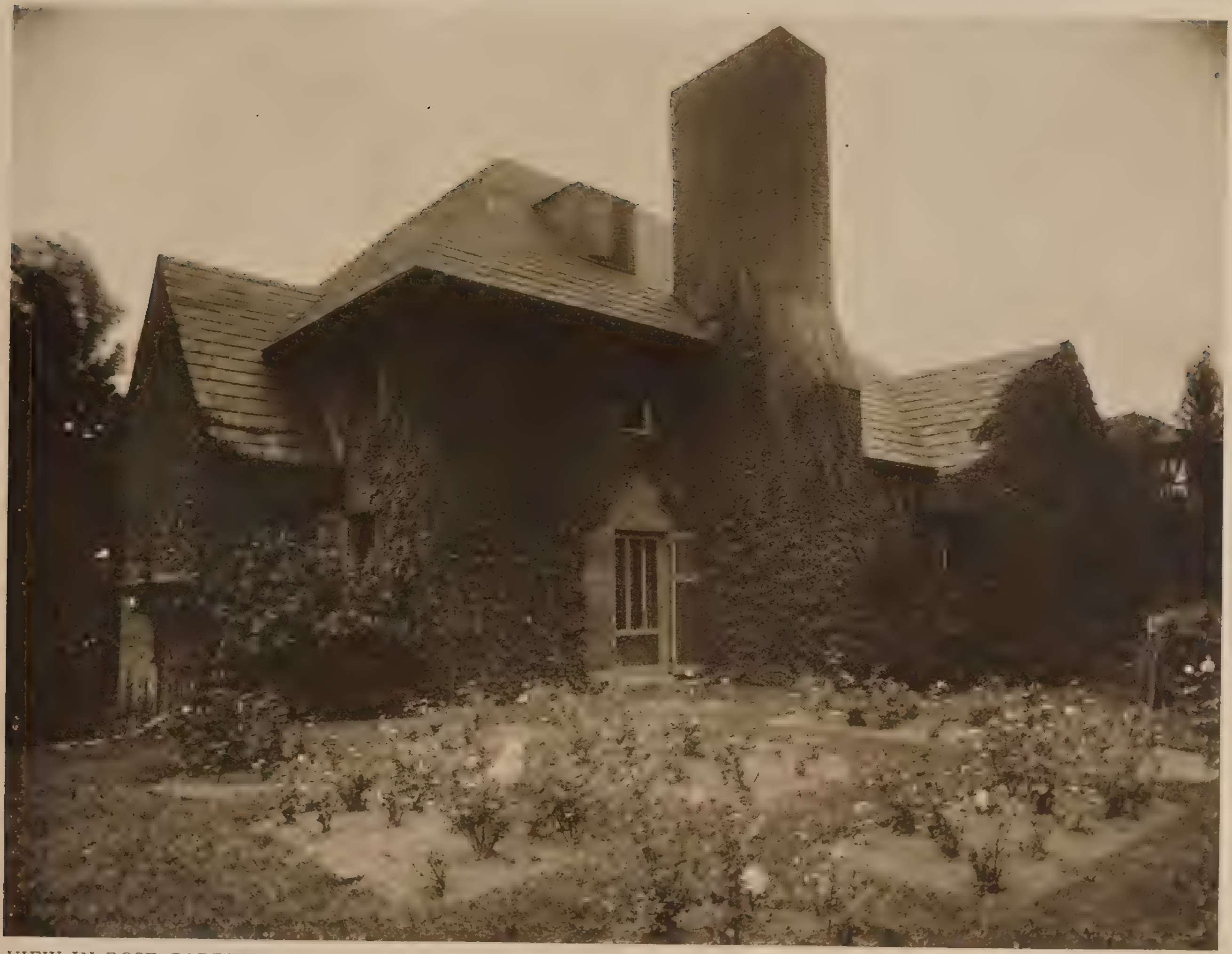
FRONT ENTRANCE.



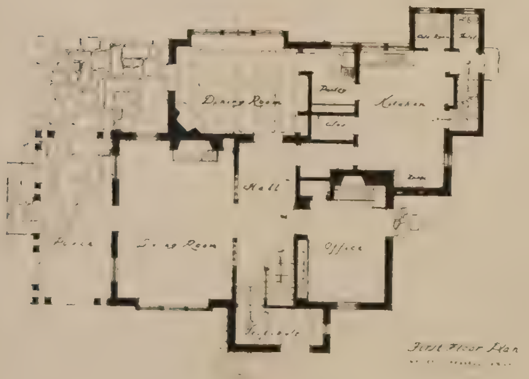
GARDEN.

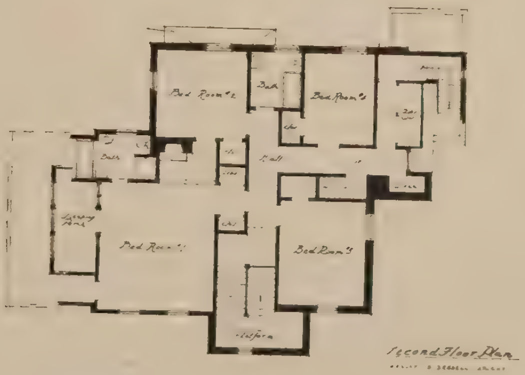
RESIDENCE, FRANK YOUNG, HACKENSACK, N. J.

Wesley Sherwood Bessell, Architect.



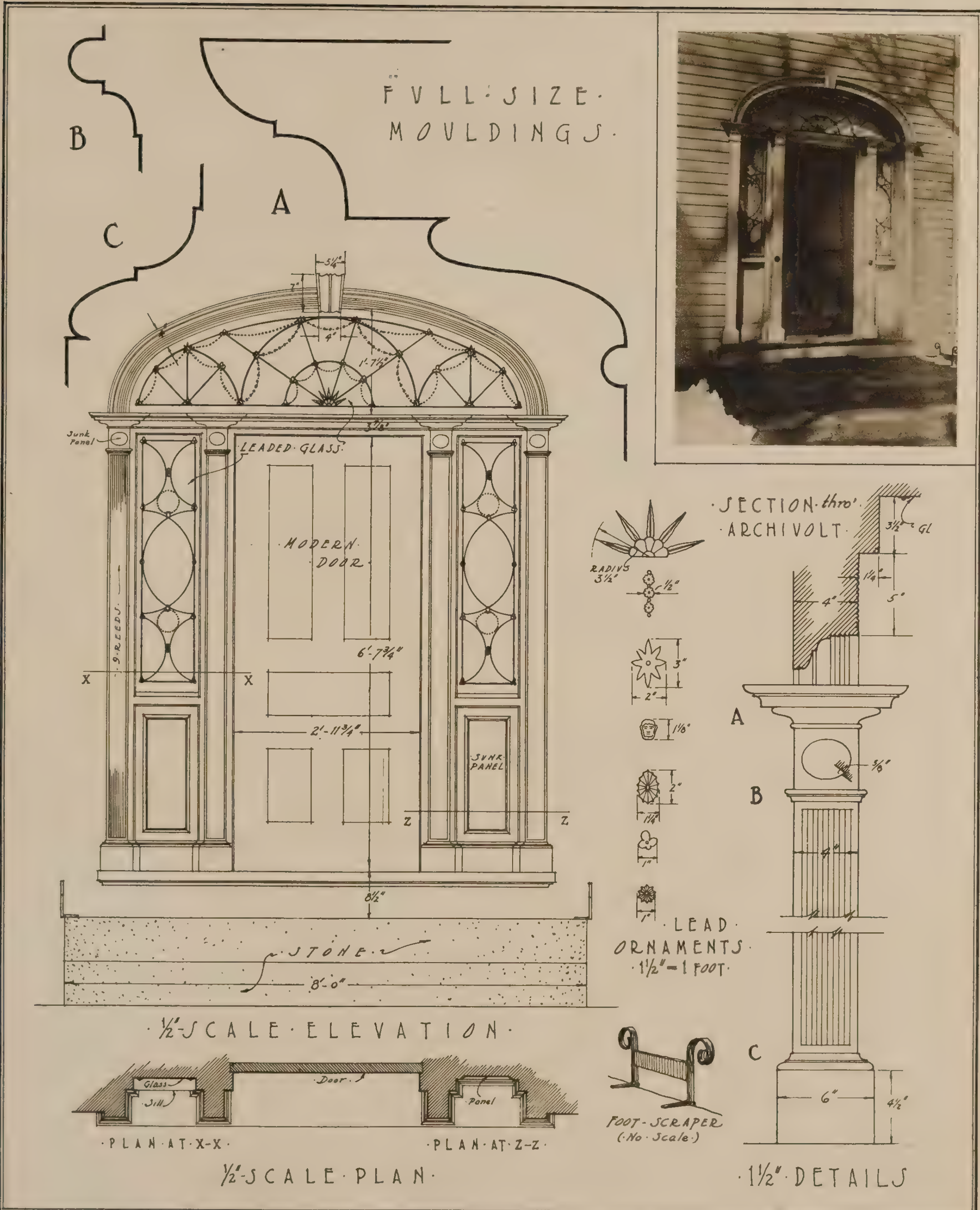
VIEW IN ROSE GARDEN.





RESIDENCE, FRANK YOUNG, HACKENSACK, N. J.

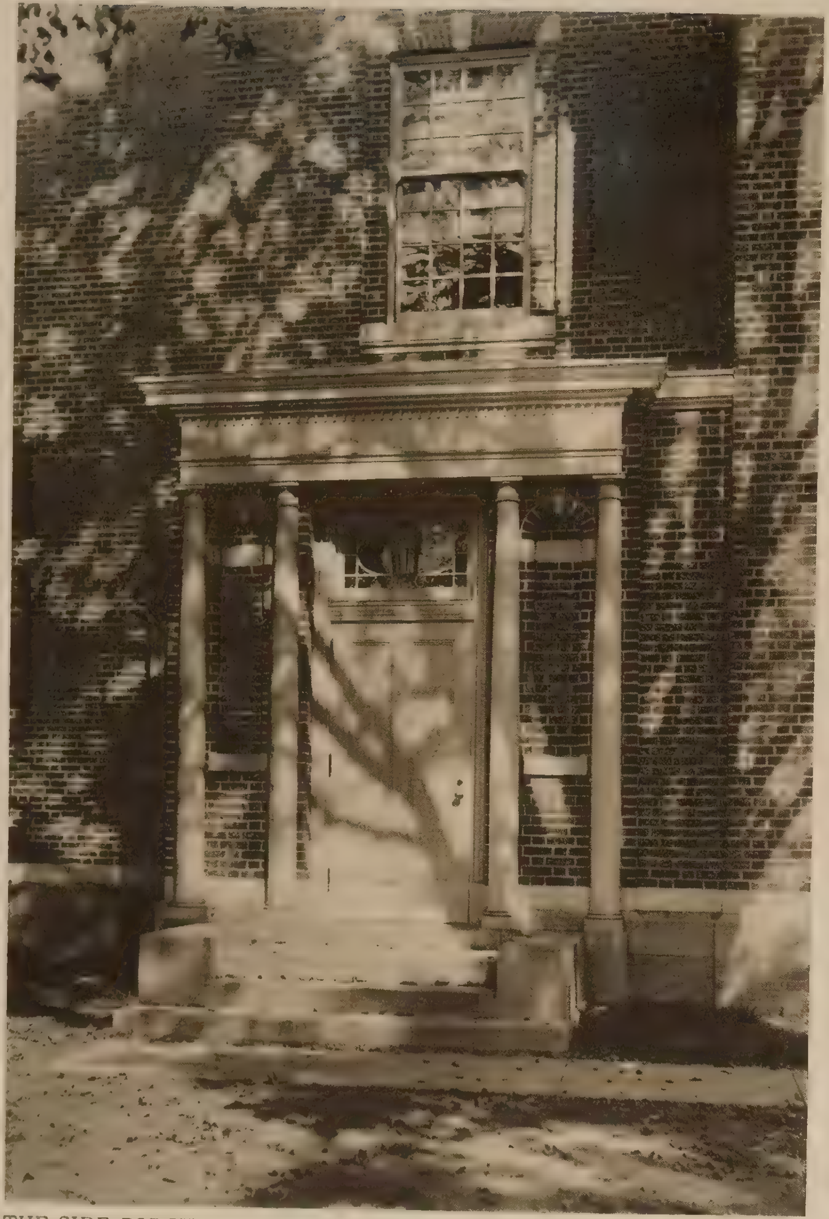
Wesley Sherwood Bessell, Architect.



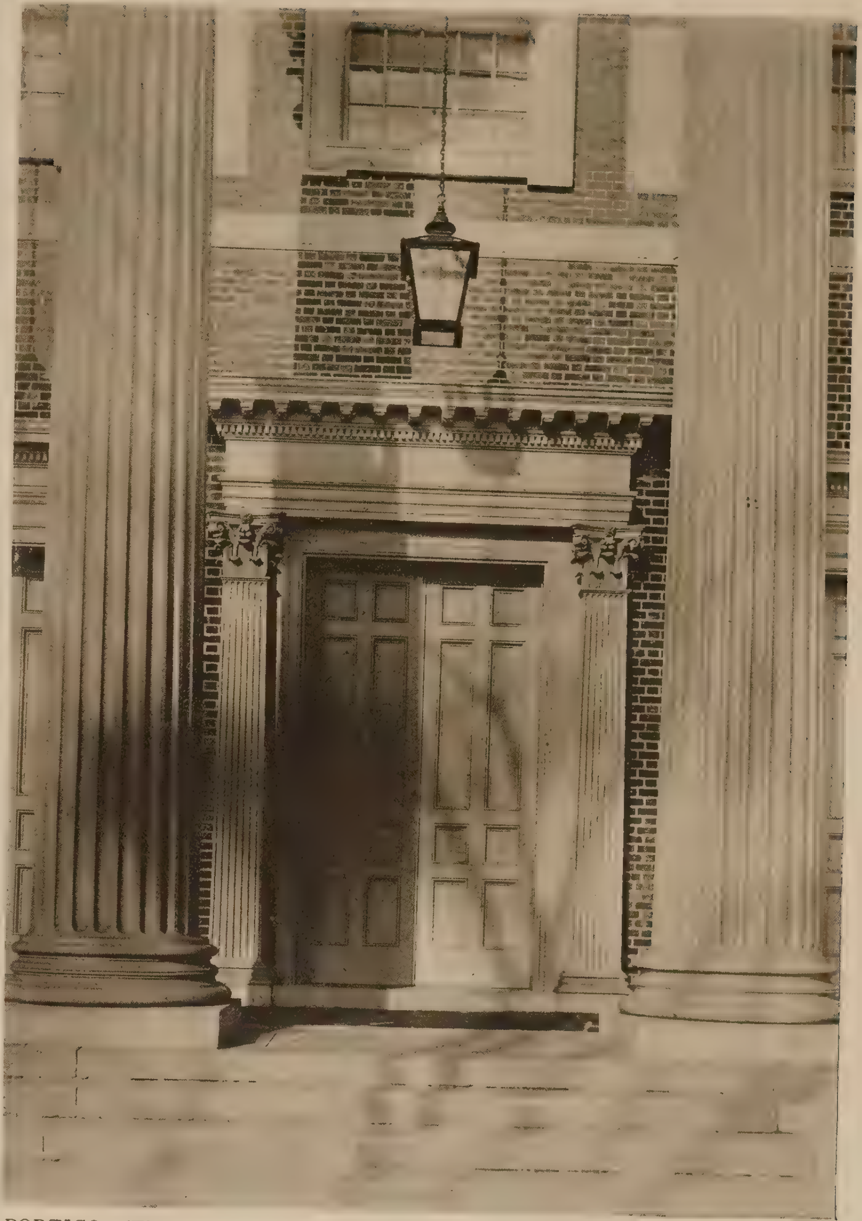
·EARLY·
ARCHITECTURE·
·OF·
·CONNECTICUT·

DOORWAY
·OF·THE·
CORNWELL·HOUSE
·CHESHIRE·CONN·

·MEASURED·BY·
J·FREDERICK·KELLY·
·DRAWN·BY·
LORENZO·HAMILTON·

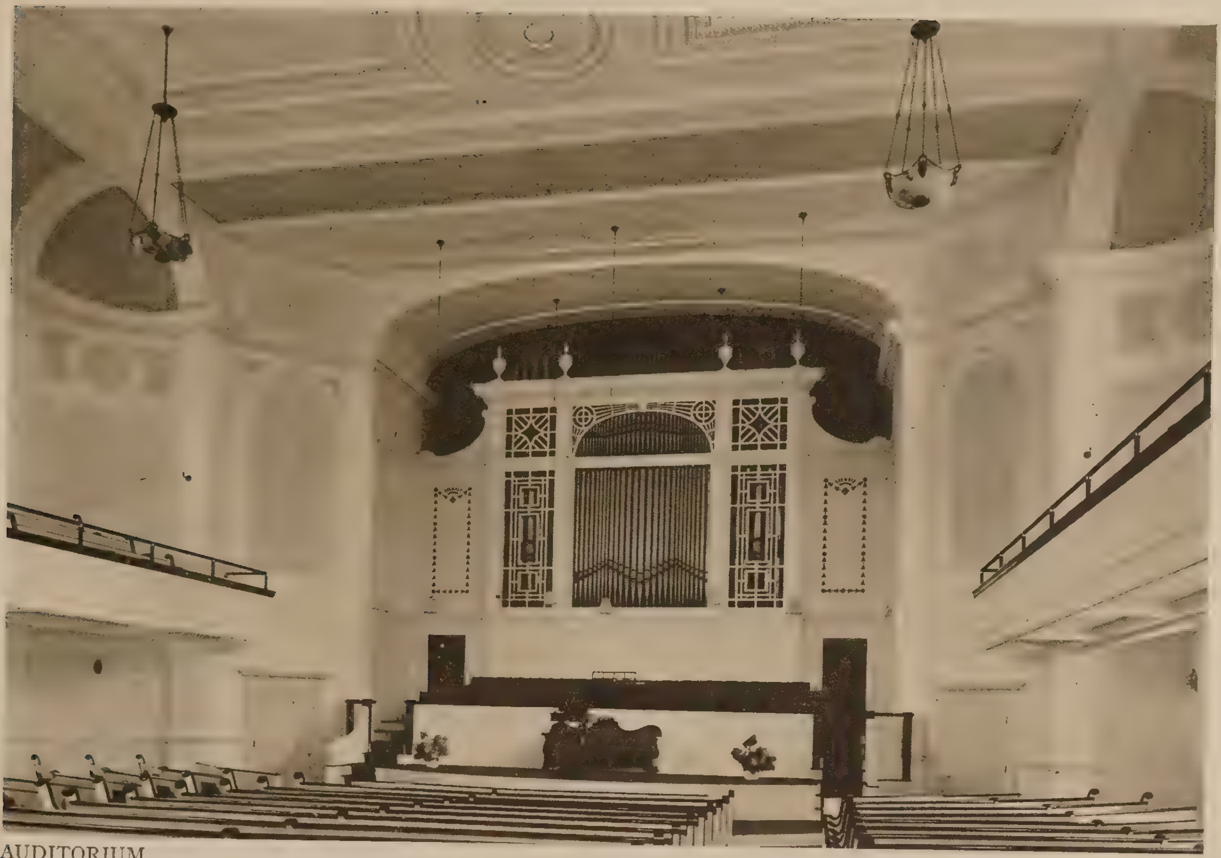


THE SIDE PORCH.

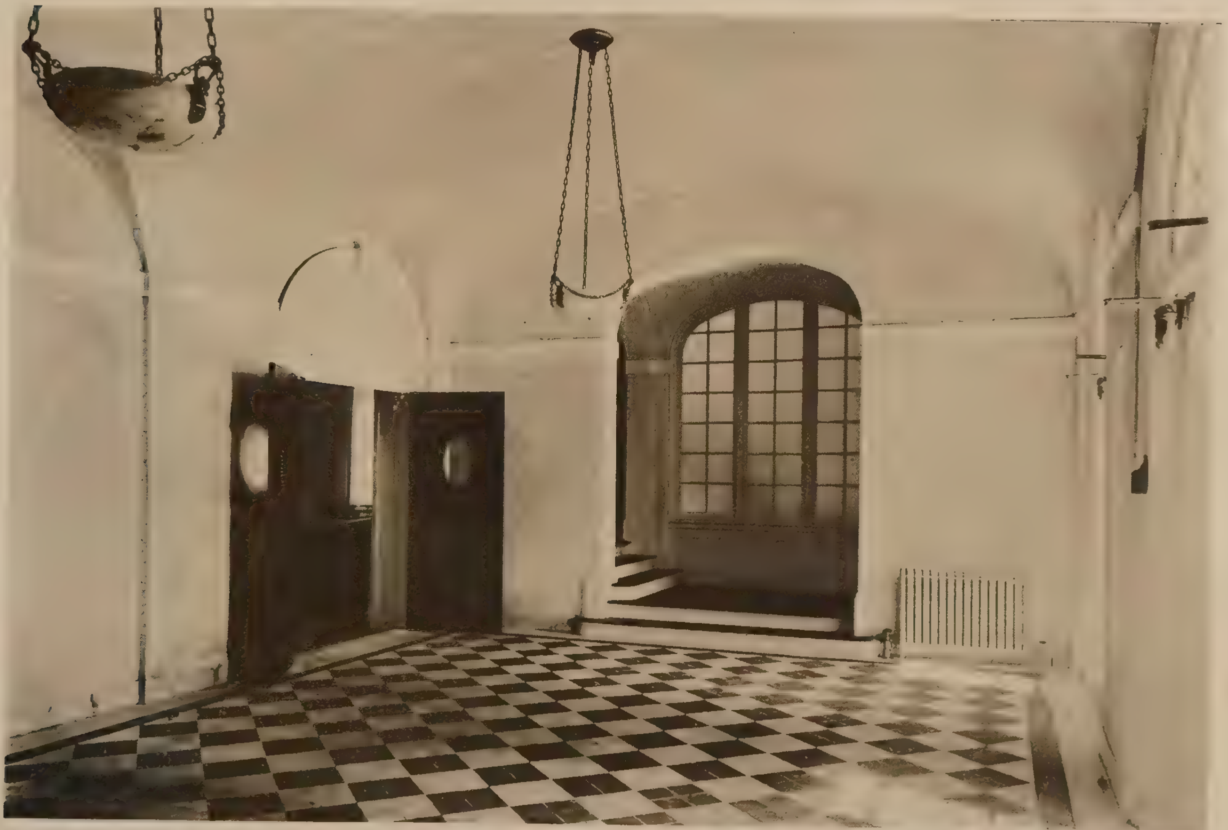


PORTICO. (The original doors in place in the new church.) Davis & Brooks, Architects.

FOURTH CONGREGATIONAL CHURCH, HARTFORD, CONN.



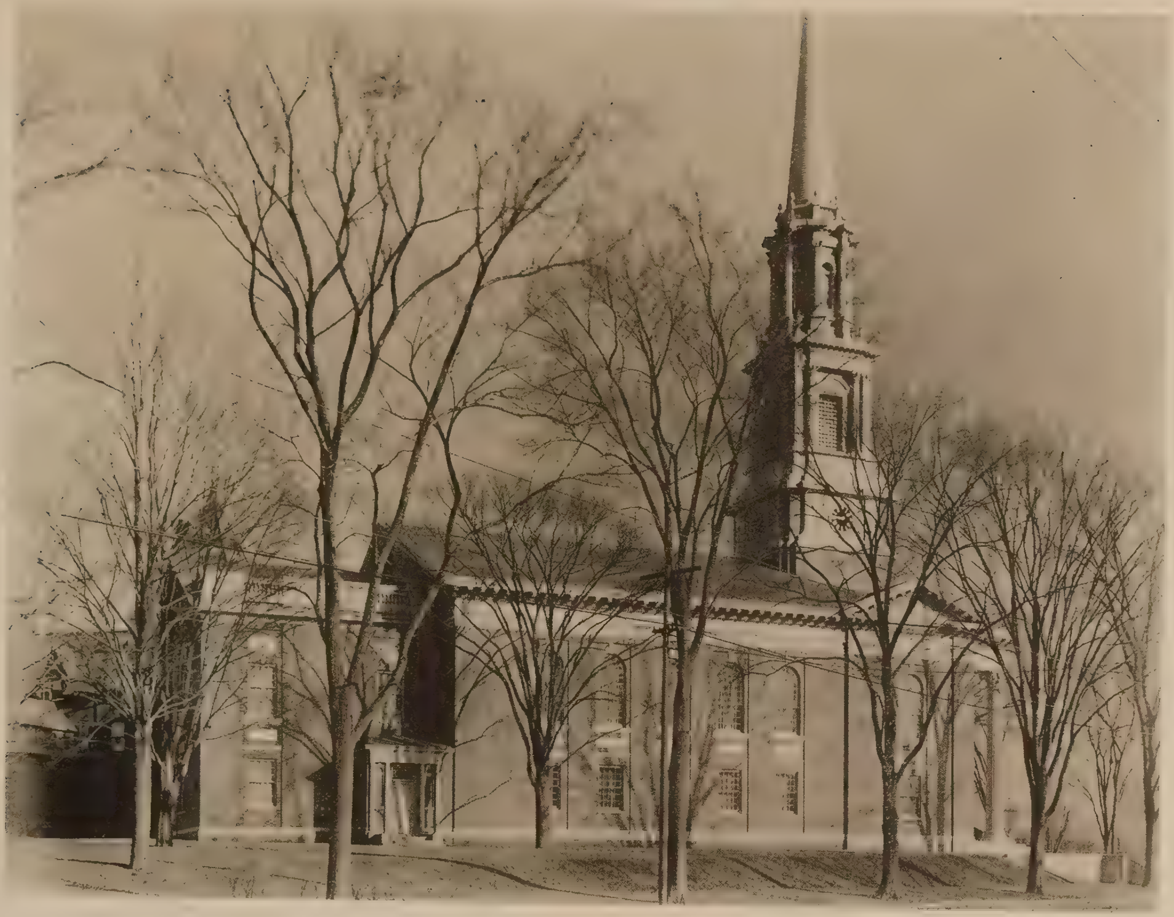
AUDITORIUM.



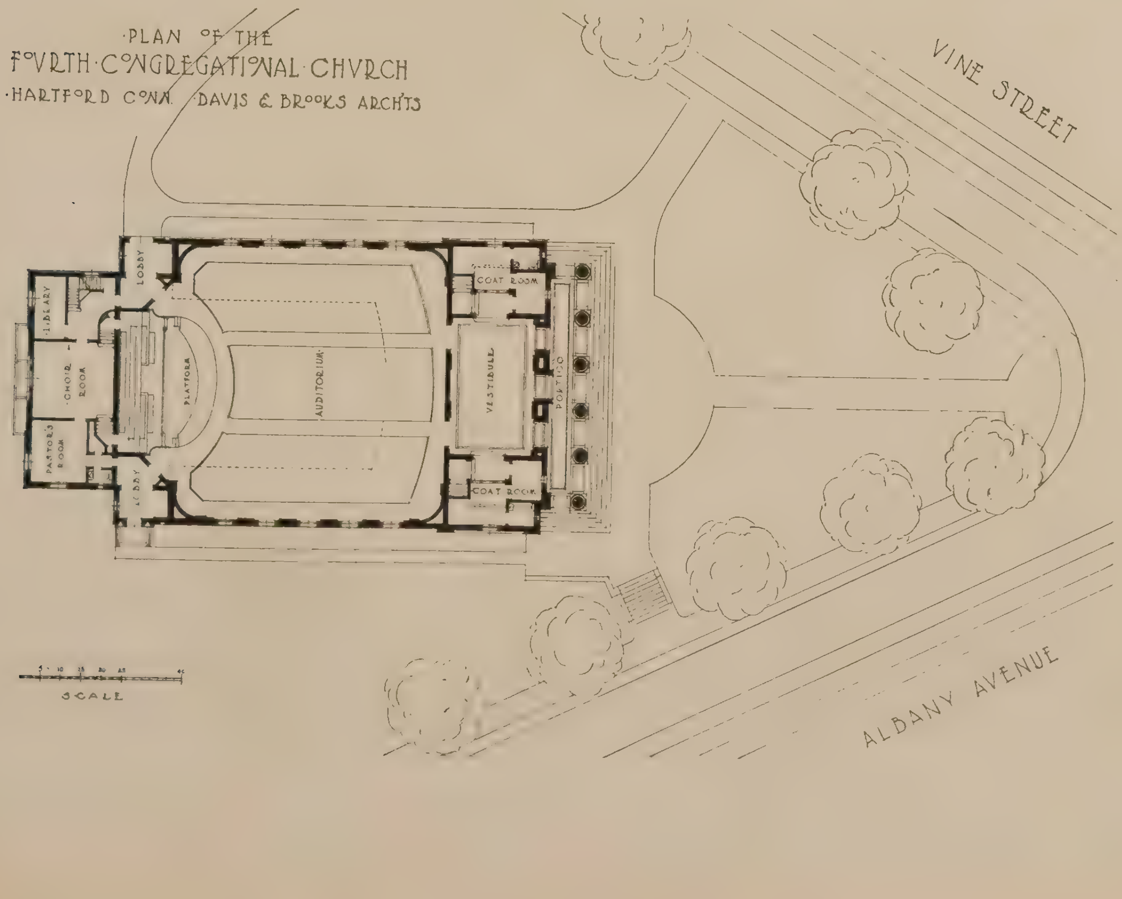
VESTIBULE.

FOURTH CONGREGATIONAL CHURCH, HARTFORD, CONN.

Davis & Brooks, Architects.



SIDE OF BUILDING, FOURTH CONGREGATIONAL CHURCH, HARTFORD, CONN. Davis & Brooks, Architects.



The Fourth Congregational Church of Hartford

Old Traditions Embodied in the New Building

By W. F. Brooks, Architect

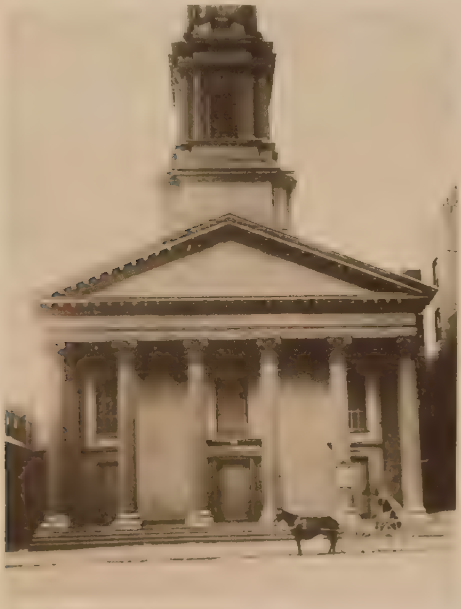
THE new building for the Fourth Congregational Church of Hartford, completed just prior to the war, has a certain historical as well as architectural interest, and shows how important work of the past may be preserved in its main features, even though the upheavals incident to modern development in our cities make a change of location necessary.

Changes of residential centres and the encroachment of business often make the abandonment of an old location necessary, but if an edifice has character, which has become associated with and a part of the life of the users, it should not be lost in making the change if it is possible to preserve it. If, also, there are characteristic parts of the old building which not only help this association of ideas but are worthy of preservation for their own beauty, it is ruthless not to attempt their incorporation in the new edifice.

The Fourth Church is a case in point. It occupied a building on North Main Street built about 1850, and by 1913 its congregation lived far to the northwest, and the encroachment of business had made its dignified porch and spire seem incongruous, but had increased the value of its real estate so that it could afford to move.

All that is known of the earlier building is that in 1848 the congregation's committee went to New Haven, and were so pleased with the general appearance of the Centre Church of that city (the one recently so beautifully restored on the green) that they gave instructions to their architect, S. M. Stone, of New Haven, to build their new church in Hartford like it. Accordingly, there arose a fine building with a Corinthian pedamental porch and well-proportioned spire of superposed orders, ingeniously varied after the manner of James Gibbs. The capitals were all of hand-carved pine and in excellent preservation.

After the sale of the property in 1913 and the purchase of a new site in the northwest residential district, the committee considered the selection of an architect by means of an informal submission from a few invited local firms. Davis & Brooks were among these, but instead of submitting drawings of a new church, they proposed to the committee a scheme which preserved the character and best features of the old church. These architects explained the value, historic, sentimental, and real, of the easily removable porch and handsome spire for so many years one of the landmarks of Hartford, and that with these as the dominant adornment they would design a modern auditorium in keeping, agreeing thus to produce far richer and more important results than the money at hand could produce in new work. Their suggestions prevailed, the new church was built, proportioned and corniced to receive its predecessor's adornments, which were moved part by part, and the accompanying illustrations show the result.

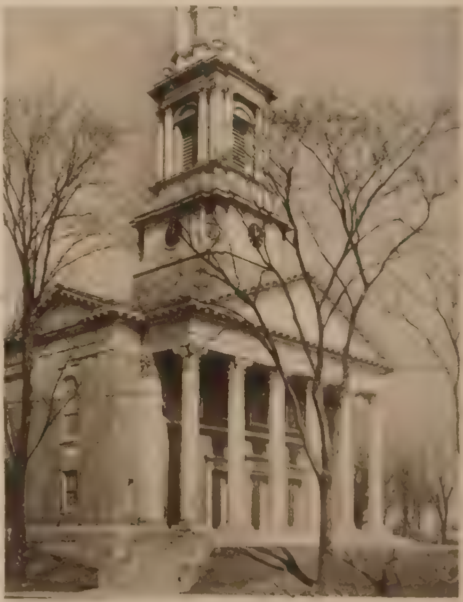

The old church, built about 1850.

The new site was especially well adapted as a setting for the porch and spire. Here there was ample space, with well-formed elms about streets making an obtuse angle, the centre of which made a particularly favorable setting for the spire. Whatever may have been the original color of this architecture, it had, in common with so many Connecticut churches of the period, become a "two shade of brown" affair, obviously to the detriment of the general effect and detail. Naturally, the color was changed to white.

Even on its commercial side this solution proved wise and showed forcibly the folly of discarding what was so valuable to those who could properly make use of it. When the architects made their proposal the sale of the old property was already an accomplished fact and there were no reservations in the deed. So, in order to carry out the scheme, it was necessary for the new owner to consent to return a portion of the edifice which he had already paid for. This he readily consented to do, as his chief concern was with the auditorium, which he proposed to convert into a "movie" house; the porch and spire, to him, simply represented the cost of removal, which he was glad to be relieved of.

While the cost at that time would have no interest or significance now, it is obvious that the mere moving and erection of these features was only a fractional part of what their new cost would have been, aside from all questions of their superiority in workmanship or their sentimental value.

[Here was a fine opportunity appreciated, and the new church with its fine old front must be a source of pride not only to the congregation but to the city of Hartford.—Ed.]


The new church

Orchestra Hall, Detroit, and the Grand Theatre, Pittsburgh

THESE two theatres are good examples of the modern American theatre by C. Howard Crane, architect, Elmer George Kiehler, associate, Cyril E. Schley, who have achieved much success in the theatre-building field.

Detail of boxes, Orchestra Hall.

Orchestra Hall is the home of the Detroit Symphony Orchestra and one of the most beautiful and modern houses in the country. The building has a capacity of about 2,200, and although it maintains the feeling of compactness, is spacious but not vast or bare-looking. This sense of compactness is attained by the happy arrangement of the balcony and the fact that the mezzanine floor is held back slightly under the balcony, which seats 1,000. The floor accommodates about the same number, while the spacious mezzanine with its horseshoe of 26 box-seats accommodates 154.

Every provision has been made to secure perfect quiet in the building. Three sets of doors exclude the noise of traffic from the street, and spacious lobbies on both the main and balcony floors provide a place for late-comers to wait while a number is being given.

The acoustic properties of the building are so perfect that the most delicate tones of the strings are clearly audible in every part of the hall, thus making the auditorium equally suitable for grand opera or chamber-music.

The stage is completely equipped for grand-opera performances, and is said to be the largest in the city, having a span of 48 feet and a depth of 45 feet. Back of the stage are 15 dressing-rooms, two of which are large chorus-rooms, besides which there is a space under the stage for additional portable dressing-rooms if needed.

The lighting of the building is one of its most successful and unusual features. Instead of the glare of white lights, canary-colored bulbs are used, which shed a soft amber light.

This is in keeping with the colorings of the Italian Renaissance decorations. The entire building is suggestive of the old Italian.

The Grand Theatre of Pittsburgh is one of the largest theatres in this section of the country, which is readily shown by the seating capacity, which is well over 2,600.

This great auditorium is devoted almost exclusively to motion-pictures. The interior of the auditorium is decorated in blue, gold, reds, and ivory, giving an intimate and cheerful effect, so essential to a successful theatre. The ceiling consists of a large central dome, and surrounding it are very highly decorated and enriched panels. The central dome is beautifully lighted by cove-lighting in three colors. Very highly enriched sounding-boards spring from the proscenium framing in the stage boxes. The hangings of these boxes as well as the main drops in the theatre have rich quality velvet velour, heavily lined and trimmed with gold brocade. The sight lines and acoustics in this theatre are perfect.

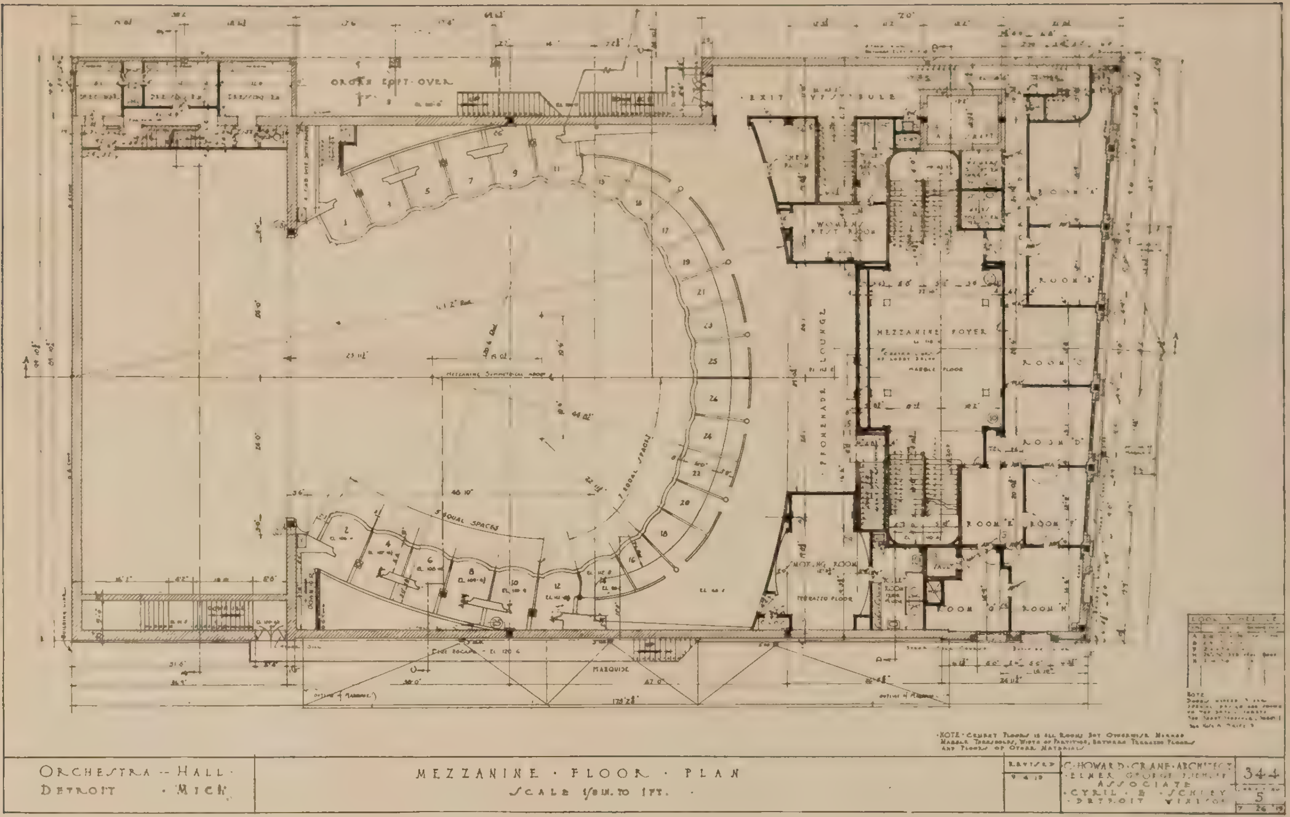
No small amount of study has been given to the beautiful interior and the adjoining lounges, promenades, and retiring-rooms.

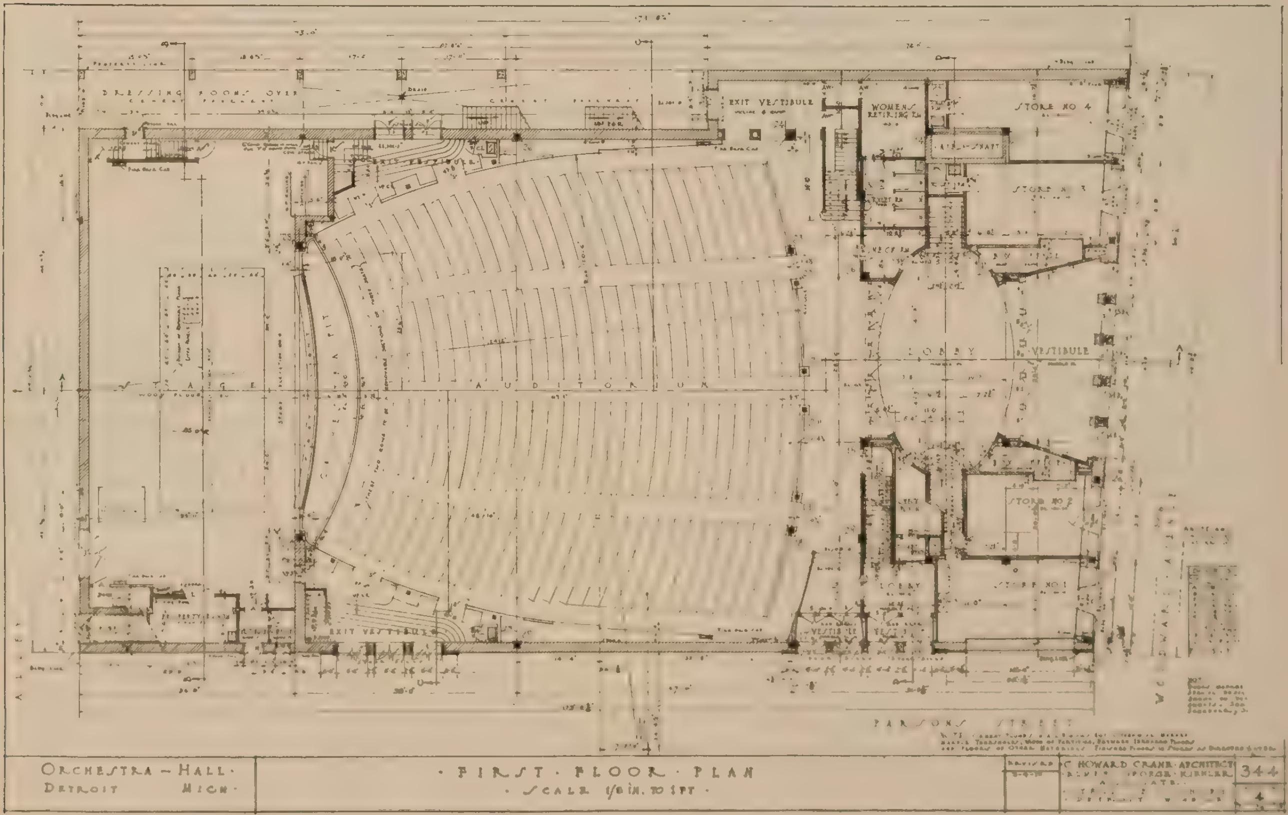
The entrance to the theatre is off a spacious arcade connecting Diamond Street with Fifth Avenue.

The walls of the entire lobby and arcade are of white Italian marble and floors of same are of Tennessee marble with verde-antique borders. On either side of this arcade are exclusive little shops, telephone-booths, telegraph-station, etc. A luxurious stairway leads from this arcade to the theatre foyer. The walls of the foyer are decorated in French gray and rise to a highly enriched ceiling. The stairways from this foyer lead to a handsome promenade and mezzanine floor, which has a large open well in the rear, giving extreme height to the foyer. Over this well is a

(*Continued on page* 242.)

Mezzanine foyer, Orchestra Hall.


ORGAN LOFT OVER
EXIT VESTIBULE
WOMEN'S REST ROOM
MEZZANINE FOYER
MARBLE FLOOR
PROMENADE LOUNGE
ROOM "A"
ROOM "B"
ROOM "C"
ROOM "D"
ROOM "E"
ROOM "F"
ROOM "G"
ROOM "H"
SMOKING ROOM
TERRAZZO FLOOR
LOGE SPACES
MARQUISE
OUTLINE OF MARQUISE
179'2½"
NOTE · CEMENT FLOORS IN ALL ROOMS NOT OTHERWISE MARKED
ORCHESTRA – HALL · DETROIT · MICH.
MEZZANINE · FLOOR · PLAN
SCALE 1/8 IN. TO 1 FT.
REVISED 9-4-19
C. HOWARD CRANE · ARCHITECT
ELMER GEORGE KIEHLER ASSOCIATE
CYRIL E. SCHLEY
DETROIT
344
5
7-26-19


DRESSING ROOMS OVER
EXIT VESTIBULE
WOMENS RETIRING RM
STORE NO 4
STORE NO 3
STAGE
AUDITORIUM
ORCHESTRA PIT
LOBBY
VESTIBULE
STORE NO 2
STORE NO 1
PARSONS STREET
WOODWARD AVE
ORCHESTRA – HALL · DETROIT MICH ·
· FIRST · FLOOR · PLAN
· SCALE 1/8 IN. TO 1 FT ·
REVISED
C. HOWARD CRANE · ARCHITECT
ELMER GEORGE KIEHLER ASSOCIATE
DETROIT
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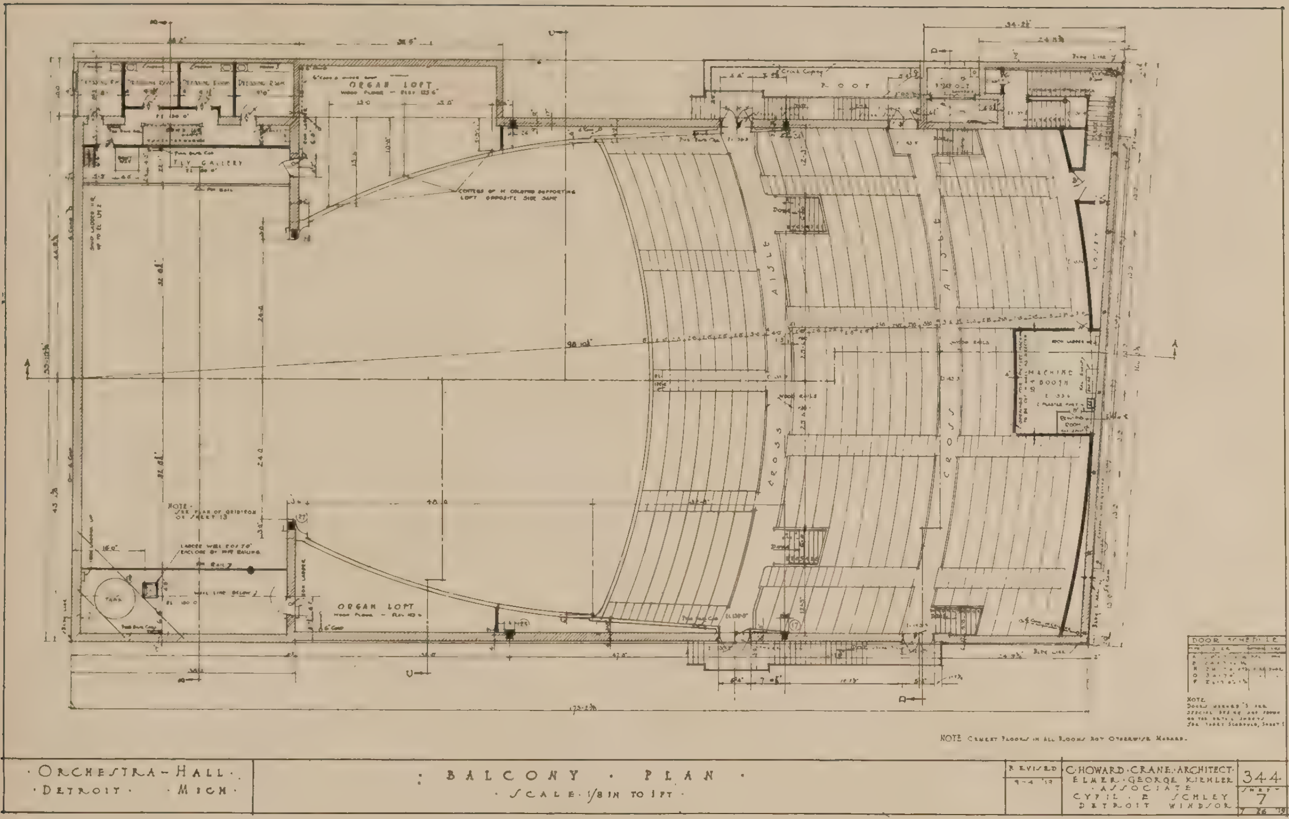
ORGAN LOFT
FLY GALLERY
AISLE
CROSS AISLE
MACHINE BOOTH
ORGAN LOFT
ROOF
DOOR SCHEDULE
NOTE Cement Floors in all Rooms not Otherwise Marked.
· ORCHESTRA - HALL ·
· DETROIT · · MICH ·
: BALCONY · PLAN ·
· SCALE · 1/8 IN TO 1 FT ·
REVISED
9-4-'19
C. HOWARD · CRANE · ARCHITECT ·
ELMER · GEORGE KIEHLER
· ASSOCIATE
CYRIL · E · SCHLEY
DETROIT WINDSOR
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SHEET
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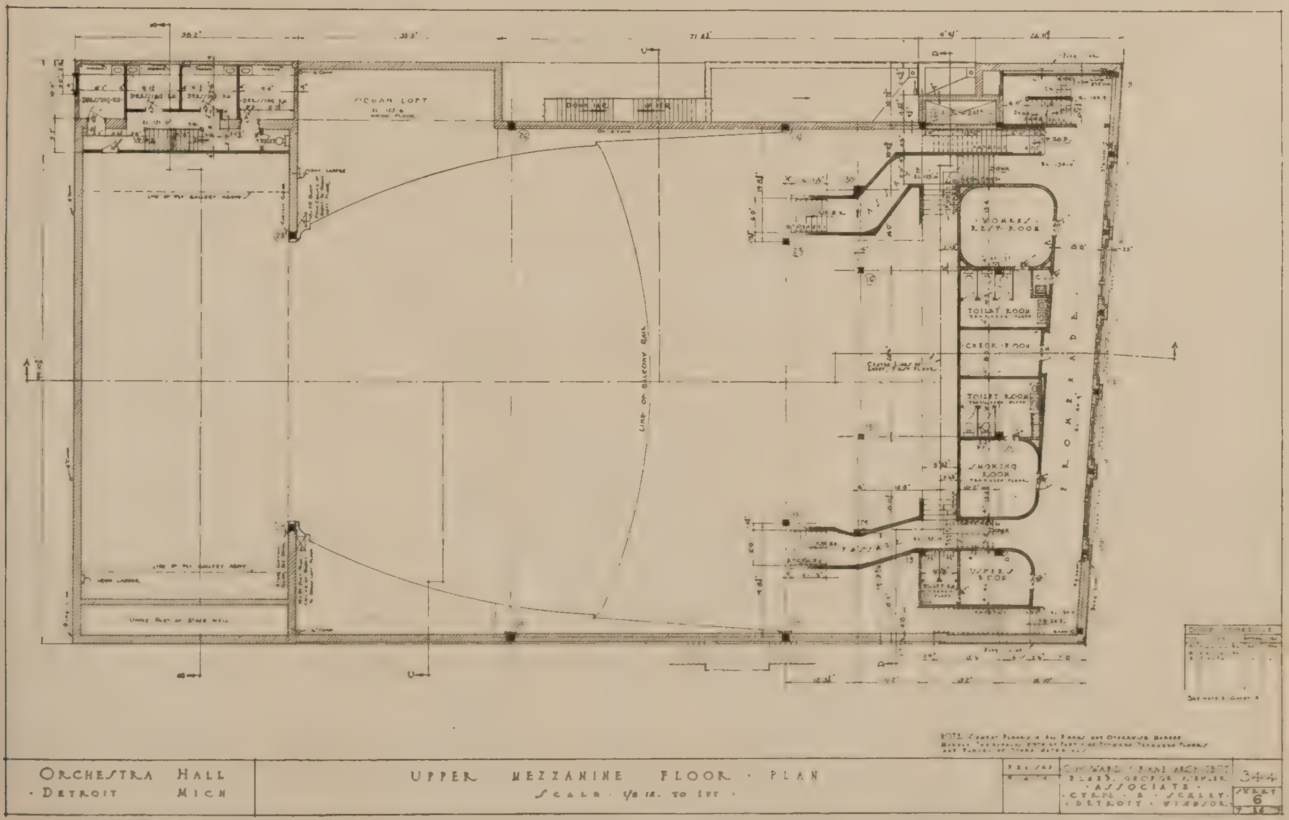

ORGAN LOFT
LINE OF BALCONY RAIL
WOMEN'S REST ROOM
TOILET ROOM
CHECK ROOM
TOILET ROOM
SMOKING ROOM
PROMENADE
WRITING ROOM
UPPER PART OF STAGE WELL
ORCHESTRA HALL
· DETROIT MICH
UPPER MEZZANINE FLOOR · PLAN
SCALE · 1/8 IN. TO 1 FT ·
REVISED
C. HOWARD CRANE ARCHITECT
ELMER GEORGE KIEHLER
· ASSOCIATE ·
· CYRIL · E · SCHLEY ·
· DETROIT · WINDSOR ·
344
SHEET
6

Promenade, Mezzanine, Grand Theatre.

(*Continued from page 239.*)

large dome which is decorated in gold-leaf, and hanging from the centre of this is a huge polychrome lighting fixture.

No expense has been spared in furnishing and equipping this theatre in every detail.

Concealed system of lighting has been used in the auditorium, together with very elaborate fixtures which are equipped with diffusers that are used to illuminate the auditorium during the time the pictures are shown. The theatre is lighted by different-colored lights and separately controlled from a switchboard on the stage which is so arranged that the lights can be dimmed and the colors blended, giving the most unusual effects.

The organ-chambers are located over the boxes on either side of the theatre. This arrangement makes it possible to procure the best effects, the thought foremost in mind being that the organ shall be one of the greatest features of the theatre.

Proposed Fraternity House for Small College

By A. Raymond Ellis

THE plans and perspective sketch herewith (page 243) reproduced are for a proposed fraternity house designed by A. Raymond Ellis, architect, and at the present time is of unusual interest because so much has been said about the type of hall or fraternity house best suited to college life. Before the war an effort was being made by some Eastern colleges to reduce the scale of living as established by many of the wealthier students. Since the war the style has been for simpler accommodations, and the above plan has been worked out to meet the prevailing requirements for a small college.

The first floor contains a large living-room, billiard-room, and library, which may be used by the members for recreation purposes, and in addition there is a large dining-room and serving-room with a kitchen and helpers' quarters in the basement. A women's reception-room is provided for their use at social functions, which are occasionally given. Above the first floor the rooms are arranged for chambers, sitting-rooms, and study-rooms. In some cases the chamber is also used as a study and is called a study bedroom. In other cases where two men wish to live together there are two bedrooms and a study which can also be used as a living-room. There are no private baths, each floor being provided with two general bathrooms. This type of building seems to represent about the average requirements for the present-day college life. The building is to be built in brownstone, with brownstone trimming and heavy Tudor slate, and leaded casement sash of fireproof construction.

It will be noticed that some of the study suites are arranged so that two single bedrooms have a common study-room; others have a single bedroom to contain two beds, the adjoining study-room being shared as in the case of the above arrangement. The latter plan seems to be the most popular with the student and is at the same time the most economical from a building and housing standpoint. The study bedrooms are arranged for one person only, as it can readily be seen that with two persons occupying the same room and also obliged to study in that room, a crowded or stuffy atmosphere results—a situation not at all conducive to rigid concentration. Therefore, on the basis of one room to each student, the opinion reached by those most acquainted with conditions is that the double bedroom with the study adjoining is the ideal arrangement. The result is, in their estimation, neither too luxurious nor too crowded.

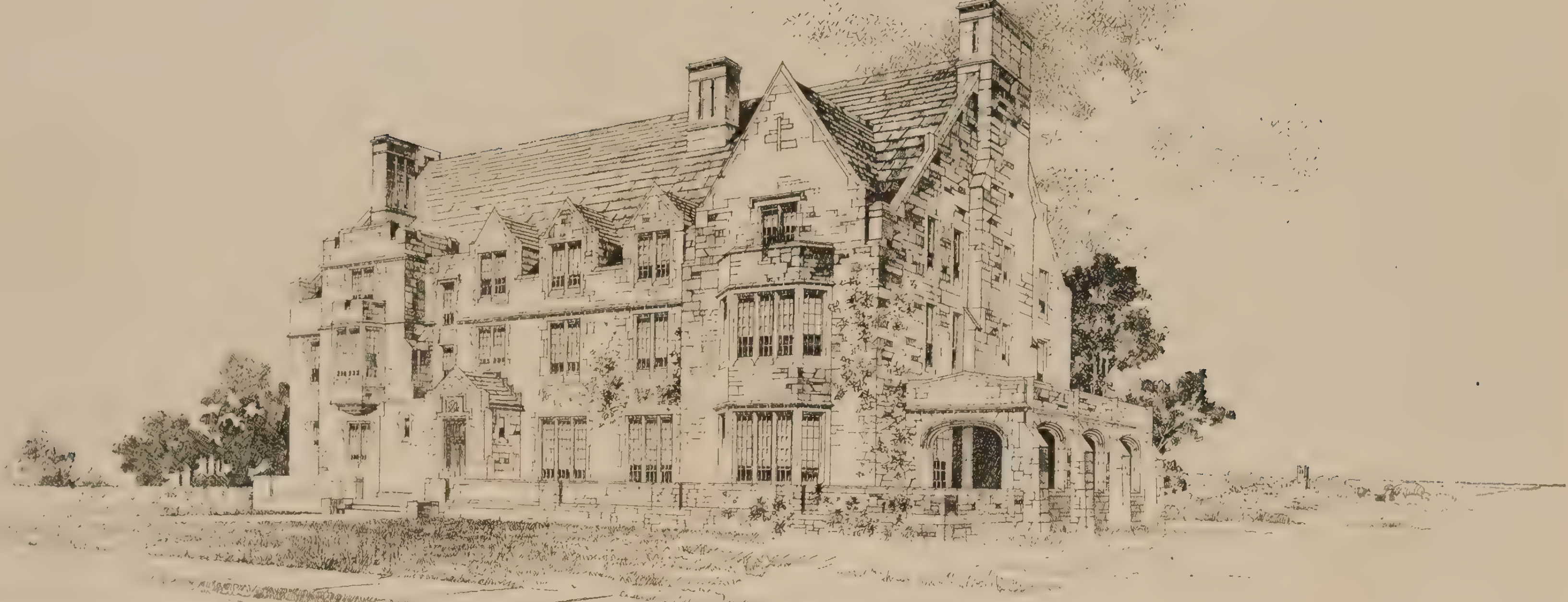
Is Electricity Dangerous?

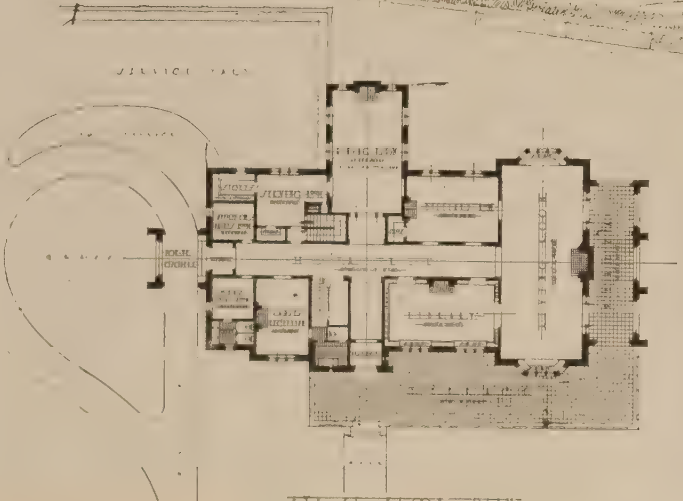
NOT if properly safeguarded. Not if the inexperienced realize and understand its danger.

A great many municipalities and State departments, realizing the necessity for compelling the careless user to protect himself, have officially ruled that no installation shall be made in their jurisdiction unless approved by city or State authorities. Some even go so far as to specify that certain types of protective devices must be used. The following extract taken from a general order issued by the Department of State Fire Marshal of Ohio shows this tendency.

"In an effort to safeguard the lives and property of the State of Ohio, I hereby make and promulgate the following ruling with reference to the installation of approved safety electric switches. In order to reduce to a minimum the loss of property by fire, caused through the utilization of open knife switches and automatic cut-outs, this department will refuse to approve any new or altered electrical equipment unless the same complies with the following requirements:

"1. That the service switch be of the enclosed safety type.
"2. That it operate outside of enclosure.
"3. That the 'on' or 'off' position be marked.
"4. That it can be locked in 'off' position.
"5. That all starting devices on motors be of the enclosed switch type."

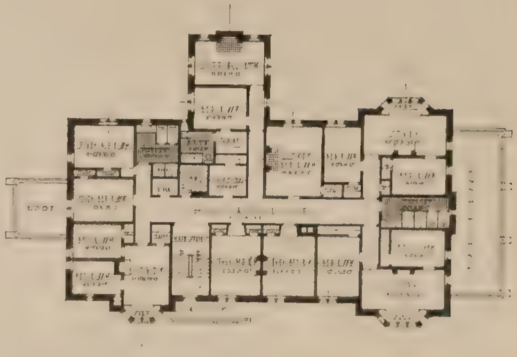




FIRST FLOOR PLAN

PROPOSED FRATERNITY HOUSE FOR
SMALL COLLEGE.

A. Raymond Ellis, Architect.



SECOND FLOOR PLAN

Philippine Architecture

By Carlos P. Romulo

MODERN architecture is finding its way in the Philippine Islands. There is not one town in that country that does not boast of two or more structures designed in accordance with modern ideas of architectural art. The Philippine Government, under whose auspices all of the public buildings are being constructed, is doing away with the old standards of government building, and following a more picturesque and attractive style of architecture.

Provincial building, Lingayan, Pangasinan.

The costs of the different public buildings vary according to their size and the sites where they are located. A building built in Manila, with all labor facilities and modern machines for construction, may cost more when built in one of the inland towns where transportation facilities are not as adequate as they are in the city, for more expense will be involved in transporting the materials and the machines necessary for the work. The Pangasinan capitol building was built at an expense amounting to about $185,000. Over 8,000 barrels of cement, nearly 1,100,000 kilograms of reinforced steel, and approximately 50,000 cubic metres of crushed stone were used in the concrete work. Of the total amount spent in the building the labor cost was $54,000.

While the ancient ecclesiastical structures that abound in the Philippines cannot be considered to be types of architectural art, when compared with the cathedrals of mediæval Europe, they stand as monuments to the untold sacrifices made by conscientious unskilled friar craftsmen who were responsible for the creation in the face of difficulties unknown in our times. These buildings are masterpieces of solidity that have defied the elements, and some of them have survived even the destructive earthquakes that have so frequently laid low all around them.

Catholic cathedral, walled city, Manila.

The present Roman Catholic cathedral was dedicated December 8, 1879. It is noted for its exceptional height. Its roofing timbers, especially those of the dome, were the best to be had in Luzon, more than usual care being taken in their choice and also in their inspection before use. The San Augustin church and convent, the most solid structure of its kind in the Islands, is 321 years old, its foundations having been laid in 1599. It is the only church in the Philippines known to be built with a crypt. A notable feature in the construction of this edifice is the massive stone ceiling over a metre thick. A terrific earthquake in 1645 opened a crack in the ceiling into which a hand could be inserted, but subsequent shocks so closed it that to-day it is almost impossible to insert a sheet of paper. The San Sebastian church is the most unique church in the city. The present Gothic structure is a "knock down" one constructed in sections in Belgium and shipped f. o. b. to Manila where it was erected on the site of the ancient structure ruined by the earthquakes. It was completed in 1891. The cupola is majestic in height; the stained glass windows brought from Europe, and illustrating events in the life of Christ, are the finest in the city, rich in tone and in the wonderful variety of the figures they contain. There are about ten more ancient churches in Manila and a score of others all over the country, all of which are beautiful structural antiquities of great interest to tourists.

The Masonic Temple and the Uy-Chaco building, the Manila skyscrapers, were built during the American administration. They are both privately owned, just as the Manila Hotel, the Kneedler and Lack and Davis buildings, the La Campana, and many others. The material used is concrete with iron and steel framework. The direction and supervision of the work is done by privately employed engineers, the government engineers taking charge only of the public buildings constructed by the government.

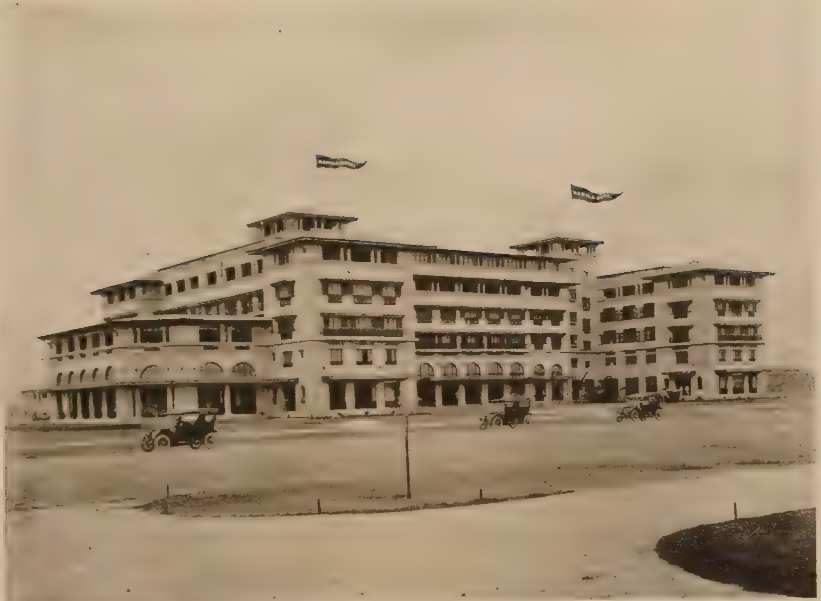
All of the present concrete public as well as private buildings were constructed only after the establishment of American sovereignty in the Philippines. Manila, the capital, and many of the provincial towns, boast of scores of beautiful structures of the modern type.

Girls' Dormitory, Manila.

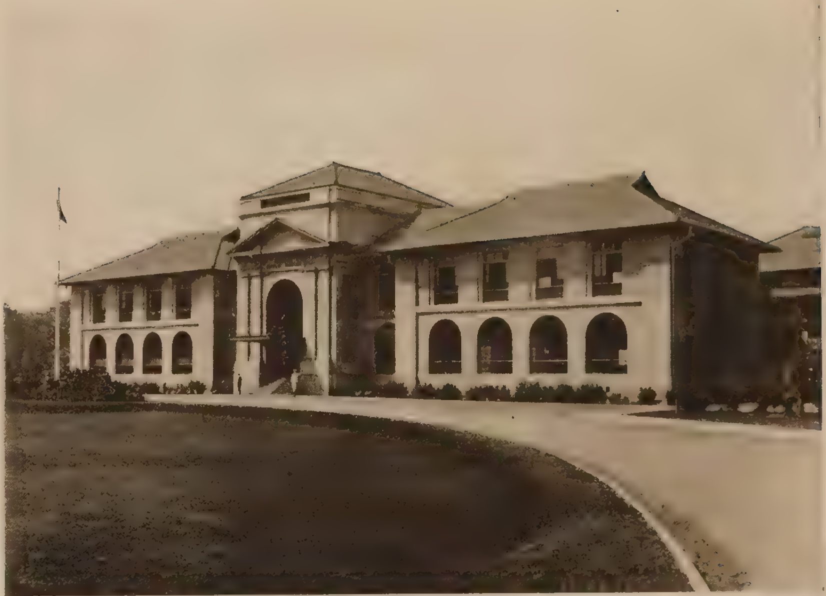
"La Proteccion de la Infancia" Building, Manila.

Municipal Building, Batangas.

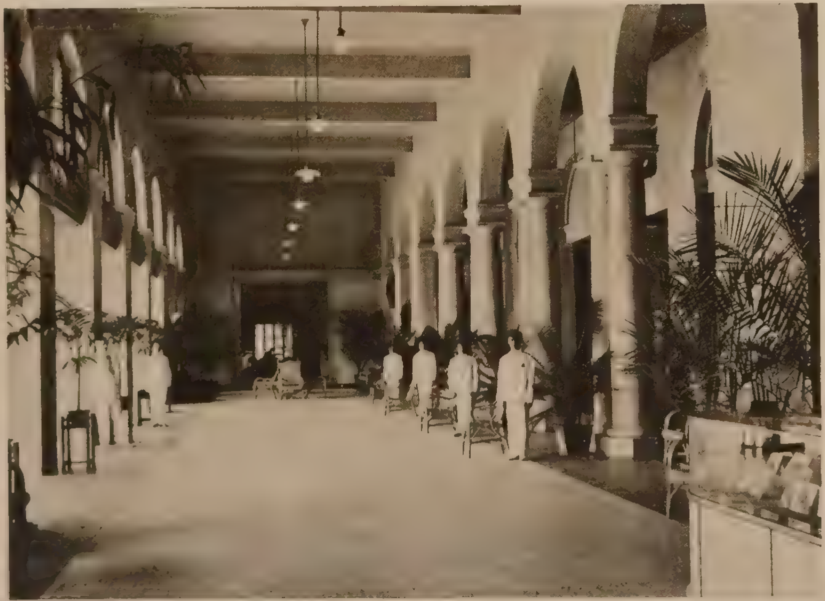
Tanauan Intermediate School, Batangas.



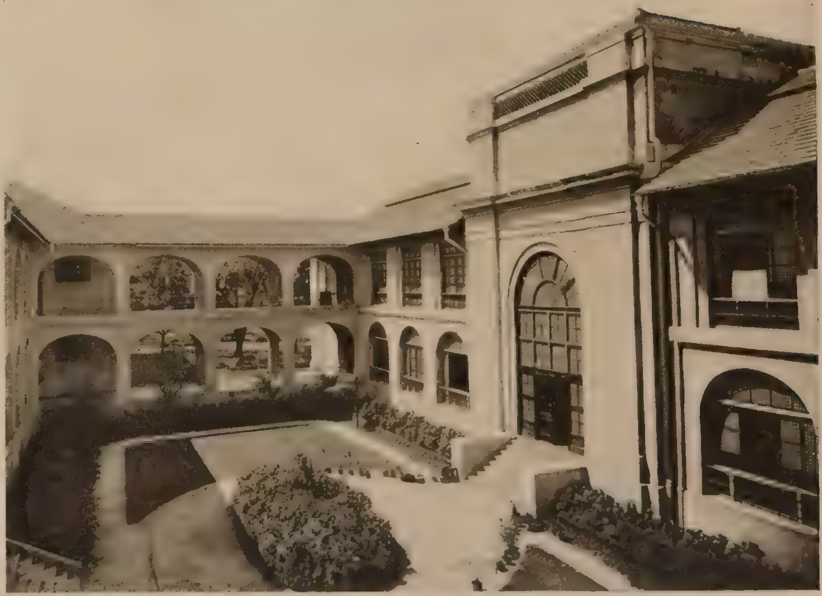
The Manila Hotel.



Philippine General Hospital.



Main Office Hallway, Manila Hotel.



Courtyard, Philippine General Hospital.

The Uses of Glass in Modern Buildings

By H. Vandervoort Walsh

Instructor in Architecture, Columbia University School of Architecture

ALTHOUGH considered to be one of the unessentials during war, yet, as we regard it in peace times, glass is a necessity to modern life. In fact, it is so intimately a part of the average building that we wonder, sometimes, why we pass such vast quantities of it without scarcely turning the head. On all sides of us, as we pass down the streets of the city, we see entire stories of plate glass, for block after block, and above, thousands upon thousands of windows; some are ordinary sizes, while others give the appearance of walls of glass. In one great office-building in New York, the Equitable Building, there are 5,000 windows, and to enclose these it required 160,000 square feet of glass. Now this did not include the doors of the interior halls or the enclosures of shafts and stairs, transoms, mirrors, skylights, domes, lighting fixtures, reflectors, glass tile and a thousand other things where glass entered into the structure. The more detailed becomes the picture the more impressed are we with the importance of this material in its relation to building.

Glass is by no means a new material, but never in the history of architecture has so much of it been used in construction. We can realize what once was the conception of the window when we look at its etymology, as being a place or slit primarily for ventilation by the wind. The great value of glass is its power to separate us from the wind and elements and yet at the same time allow the daylight to come in. But the extent to which we use even glass in such vast quantities is because of our improved heating systems that counteract the warmth lost through the glass by radiation and conduction. Every square foot of glass that we use means the loss each hour of one British thermal unit of heat for each degree of difference between the inside and the outside temperatures. It is estimated that for the average office-building, using the typical arrangement of windows, that the ratio between the heat lost through the walls to that lost through the windows is as 4½ is to 1. It is also commonly considered that in one hour one square foot of glass will cool 75 cubic feet of air. Therefore, it is quite evident that the larger amount of glass we use in a building the larger will have to be our heating-plant and the greater will be our coal bill.

But against this is the ever-increasing appreciation of the value of daylight. Not only does the lack of good daylight increase the cost of artificial illumination necessary to take its place but its absence causes most of the evils of disease and fatigue in work and play. It has also been calculated that 59.5% of the accidents in industrial buildings are the result of improper illumination. The tendency, therefore, is to use more and more glass in the building, rather than hesitate about the increase on the coal bill.

The various kinds of glass which are used are made from nearly the same substances. Some form of silica, such as river or ocean sand, combined with salt-cake, soda-ash, limestone, and carbon make window-glass. Plate glass is made of the same ingredients, with sometimes a little arsenic added. All these materials are melted together in a great pot furnace by gas until the whole becomes molten, when it is run into the purifying part. At the end of this part, or refining tank, the glass metal is ladled from the top at the refining end where floaters are used to separate the unrefined from the refined. Where window-glass is made, the molten mass is blown and whirled into long cylinders by compressed air, and these are cut open along the sides by a diamond or hot point after they have been placed upon a flat table. When these cylinders are reheated, they are made to flatten out, and while they are still warm are polished. This method of manufacturing gives to the common window-glass a slight bent and wavy surface which is the unavoidable result of the original cylinder. In glazing, it is always necessary to put the convex side out, in order to reduce the effect of this waviness as much as possible.

This window-glass is known as sheet glass, and is graded as *Double Thick* and *Single Thick*. The former is ⅛″ thick and slightly less; the latter is 1/12″ thick. The usual stock sizes vary by inches from 6″ to 16″ in width, and above this they vary by even inches up to 60″ width and 70″ length for *Double Thick* and up to 30″ × 50″ for *Single Thick*. However, it is customary to use the *Double Thick* in all window-panes over 24″ in size. Both of these grades are classified into AA, A, and B glass according to the defects of manufacture. Such defects are termed blistery, sulphured, smoked stringy, stained, etc. In all cases of sheet glass, however, in spite of certain names given to special grades, there is present the wavy texture of the surface which is due to the method of manufacture.

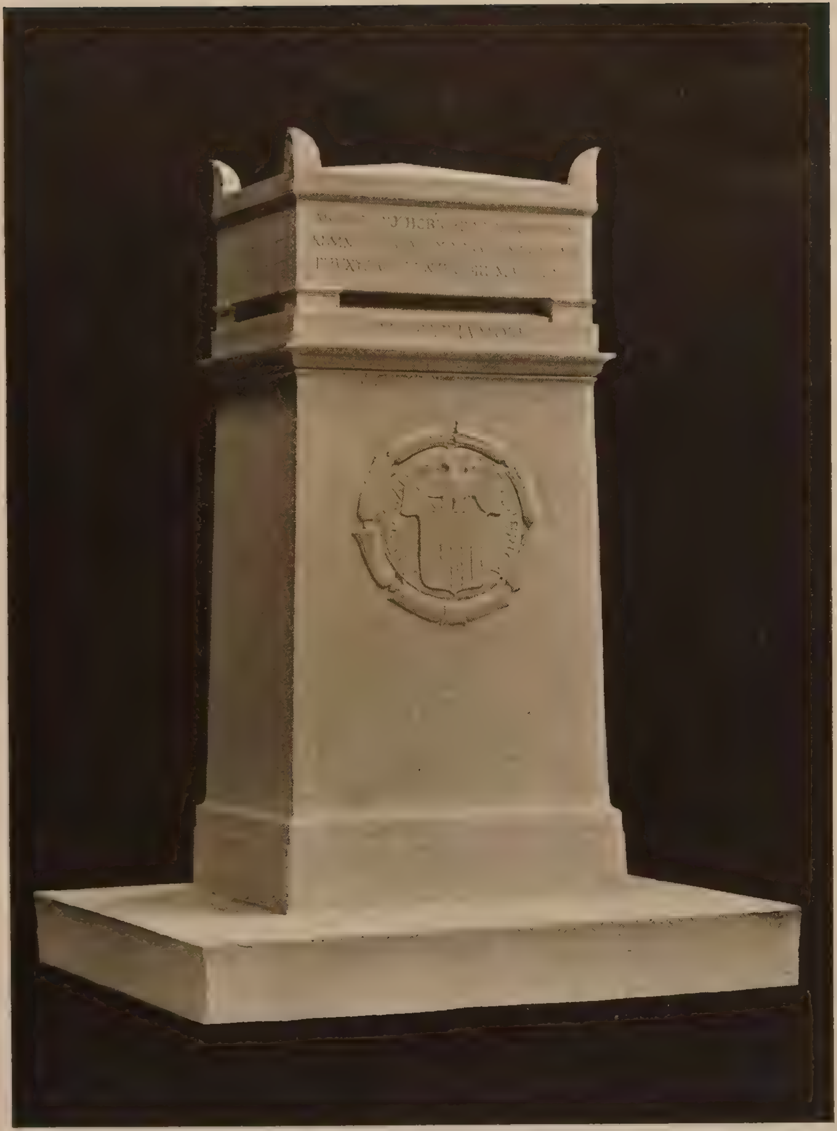
Most window-glass is now put in the sash by the lumber mills, and the painter is not called upon to do this, as in the past. The usual method of holding the glass in the rebated sash is with zinc triangles, spaced 8″ or 10″ on centres and finishing with putty. As the cost of glazing is materially reduced by the mill system, a safe rule to follow in considering cost is that the larger the pane the greater the expense. In large buildings it is much cheaper to divide the panes into small units.

Plate glass is made in quite a different way to sheet glass. It is really a cast and rolled glass which is ground and polished to a plane surface. The molten glass is poured out onto a large table, where by means of rollers it is flattened to the required thickness, this thickness being maintained by metal strips over which the rollers pass. These sheets are then annealed, and become what is known as *Rough Plate*. To make the polished plate glass, the rough sheets are examined for defects and the largest and most perfect pieces are cut out and fastened by plaster of Paris to a revolving table. Many heavy shoes of cast iron are then revolved over the glass, and with the aid of an abrasive material the surface is worn down to a plane. To polish, felt shoes are substituted for the iron ones, and the abrasive material is made finer, generally being liquid rouge.

Plate glass is cut into stock sizes, varying in even inches from 6″ x 6″ up to 144″ x 240″ or 138″ x 260″. The usual thickness is from ¼″ to 5/16″. A thinner glass can be obtained, 8/16″ or ⅛″, but it costs more than the standard thickness, because it must be ground down from them.

In order to meet this difficulty, a sheet glass was put

(*Continued on page 249.*)

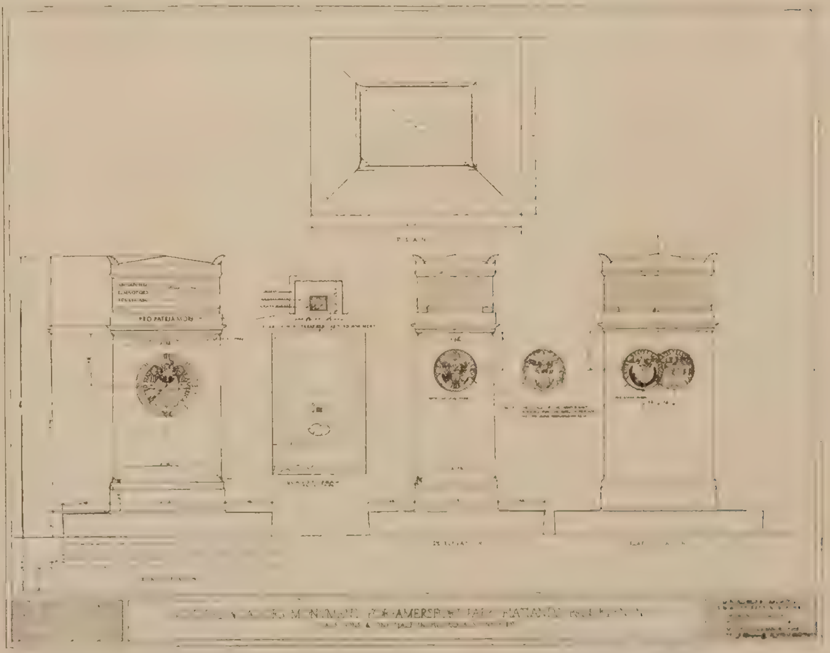


Small local war memorials are often the despair of our Art Commissions, conditions attending them, due to the limit of scope, leaving them open to the tendencies of being stereotyped and taking the form of private cemetery memorials. The exercise of a little care and thought, however, may prove the difficulty to be not so great.

The little memorial for Flatlands, Brooklyn, for deceased soldiers, has as its theme the ashes on the altar of sacrifice, a pedestal supporting a small casket on which are inscribed the names. The constituent parts are so expressed, however, as more to be felt than to be distinctly apparent, each in its function, so as to form a unit to which both parts are complementary by lines and material, with inscription expressive of the sentiment:

"PRO PATRIA MORI

TO THOSE WHO GAVE THEIR LIVES THAT DEMOCRACY MIGHT LIVE."



Joseph M. Berancer, Architect

(*Continued from page* 247.)

on the market which was heavier than the ordinary, and called crystal-sheet, 26 ounces. It, however, has all the defects of waviness which characterize the cylinder-blown glass, and aside from its heavier appearance, it cannot be compared to plate glass.

The very finest specimens of plate glass are used for mirrors, because the use of anything but the smoothest surface is quite out of the question. Small mirrors made from the sheet glass are sold for the cheap trade, but the distortions which they produce bar them from any other field.

In the endeavor to secure more and more daylight in the building, a so-called prism glass has been developed to meet the conditions of the lighting of offices and stores located in the heart of our cities. When we consider the fact that the amount of daylight entering a window is from 40 to 75 per cent of that falling on the façade of the building, and that 25 to 60 per cent of this is cut off by the window-frame itself, and also that the thickness of the wall and the height of the building across the street or the depth of the court cuts off just so much more daylight, the need of some form of glass which will bring the light from the sky as much as possible into the building is quite evident.

For purposes of presenting these needs clearly, look at the following tables:

ILLUMINATION OF THE STREET FAÇADE

NUMBER OF STREET WIDTHS AT WHICH A POINT ON THE FAÇADE IS BELOW TOP OF BUILDING OPPOSITE.	PERCENTAGE OF ILLUMINATION LEFT.	FOOT-CANDLES OF ILLUMINATION.
½	0.	243.3
1	53.	128.9
2	19.2	46.6
3	9.4	22.9
4	5.5	13.2
5	3.5	8.6
6	2.5	6.2

ILLUMINATION ON THE COURT FAÇADE

NUMBER OF COURT WIDTHS AT WHICH A POINT ON THE FAÇADE IS BELOW THE TOP OF THE OPPOSITE WALL.	FOOT-CANDLES OF ILLUMINATION.	
	END-WALL	SIDE-WALL
1	103.9	109.9
2	34.3	25.9
3	14.2	9.0
4	7.0	4.0
5	3.8	2.1
6	2.3	1.2

If we look at the following ordinary example we will see what effect the thickness of wall has upon the light entering. Here the windows are supposed to be without frames to shut off the light. One of them is 2′ x 4′ and set in a wall 12″ thick, and we find that it has 53 per cent of its light cut off by the wall. For a window twice as big, 4′ x 4′, set in a 12″ thick wall, the percentage of light loss is only 40 per cent. On extended observations it has been found that for a window of constant size the percentage of light loss is proportional to the thickness of the wall, and for a given thickness of wall the percentage of light entering increases with the height and width of the window.

It is quite evident, then, that if we can secure a larger glass area, we will secure a greater proportion of light, and that if we can secure a glass which will deflect the daylight around the corner of the wall opening into the room, we will also secure more light. These two factors have developed two solutions: one is the use of large steel factory sash, where the entire wall is made of diffusing glass, and the other is the use of prism glass which deflects the angle of daylight, as it shines down on the façade, into the building. This prism glass has one side flat and the other corrugated with small prisms which are designed for deflecting the light at the particular angle at which it shines down from the sky onto the window. Angles from 70 to 40 degrees are capable of being deflected inward, and different prisms are made for different angles between.

In a room 30′ or deeper, an increase of light from three to fifteen times that which ordinarily would enter has been accomplished by using this prism glass in the upper sash of the window. In certain cases, an increase of fifty has been recorded. At the bottom of deep courts, where the angle of daylight comes down very steeply, canopies of prism glass are used with much satisfaction.

There are two kinds of prism glass. One type comes in small squares of about four inches across, and these squares are set together to form large areas of glass over store-windows and such places by fastening them together with copper bands which are electrowelded into one solid frame. This system of small units permits of the use of several different prisms to meet the conditions, and also makes possible a higher grade product.

The other type is made in large sheets, and can be placed in one piece in the upper sash of a window. This includes all those ribbed glasses which approximate the principle of the true prism glass. Imperial prism plate is polished on one side, and has a number of different prism patterns for the other. It is made in sheets of 54″ x 72″ and cut to smaller sizes. Imperial skylight prism glass is made in plates 18″ x 60″ and follows the requirement of the National Board of Fire Underwriters. There is an ornamental prism plate glass which has just enough of the prismatic qualities to make it diffuse the light and secure a semiobscure effect.

Another pattern, showing a combination of ribbed and prism design, and also a pattern showing this same combination running crosswise in squares have shown high diffusion and deflecting qualities for use in industrial buildings.

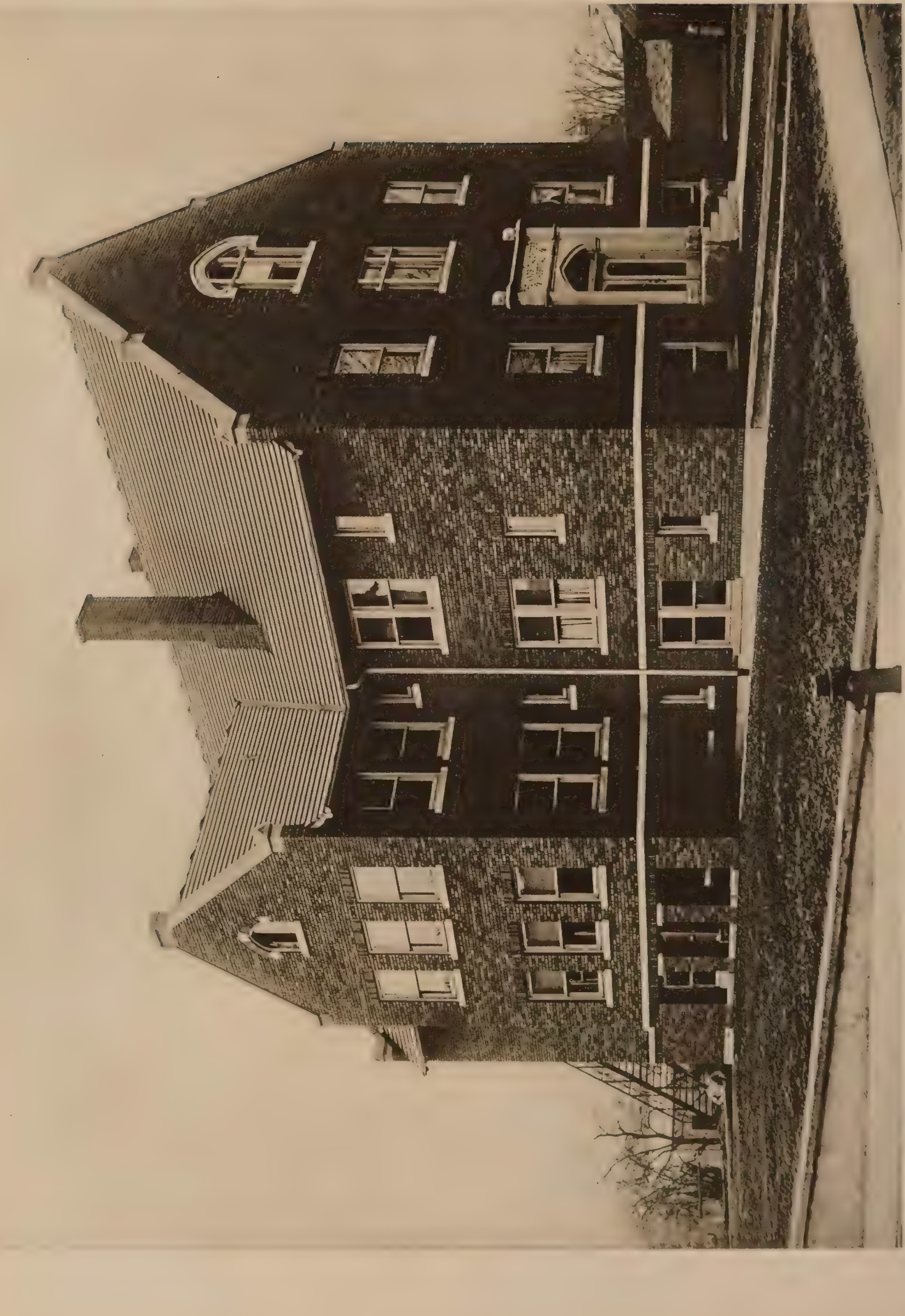
Along similar lines, sidewalk lights have been developed to give illumination to the basement. Some patterns use the principle of prismatic deflection in its pure form, but most are satisfied with a good infiltration of light, practical to the wear and tear that this glass is subjected to. Formerly, glass lights, used in connection with sidewalks, were simply heavy pressed or cast glasses which contained a considerable amount of manganese that gave a purple tint, and prevented a maximum amount of light to pass through. This glass was also brittle, and it scaled off or chipped under the wear. To-day, however, with a careful process of annealing, and the elimination of the manganese, a brilliant, tough and resilient glass is manufactured.

It has been found by experience that any sidewalk lighting must be designed along such simple and adaptable lines that its use is unlimited. It must give a minimum glass area for the strength of the framework, and the setting must be waterproof. When a glass is broken, it must be easy to replace, and an allowance for expansion must be made. Of course the glass used ought to be clear and tough and non-chipping.

The causes of failure of sidewalk lights are due to poor glass, expansion of concrete frame, vibration of the structure, and expansion of the adjoining sidewalk or street. To meet some of these difficulties, the walk should be designed to carry greater loads than those to which it will be subjected, and waterproof expansion joints should be used.

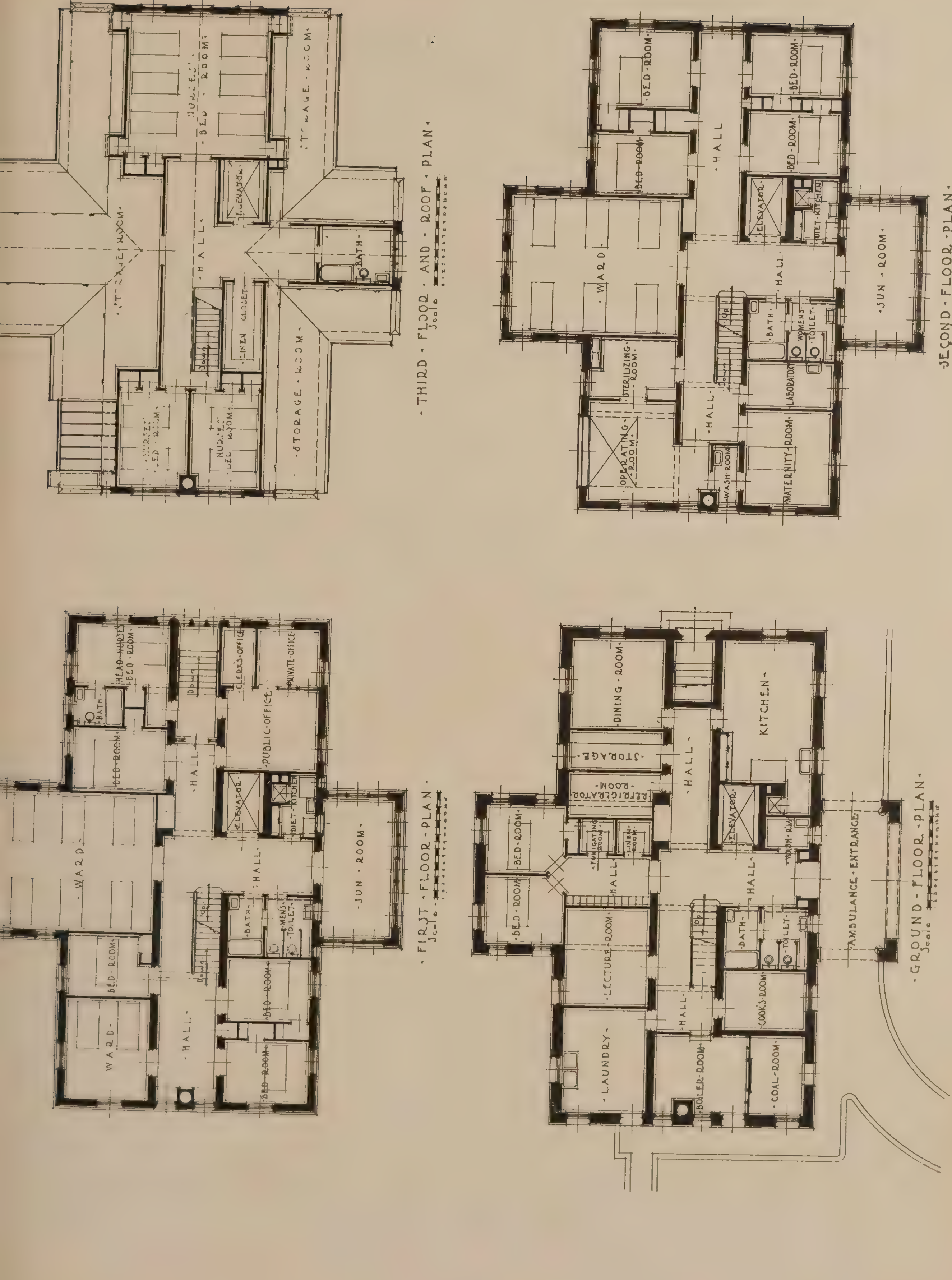
There are two patterns of glass used in sidewalk lighting. One is the square type which allows from 60 to 75 per cent glass area, and the other is the round pattern which allows from 30 to 50 per cent glass area. One make of the

(*Continued on page* 252.)



KING'S DAUGHTERS' HOSPITAL, MADISON, IND.

Herbert L. Bass & Co., Architects.



THIRD FLOOR AND ROOF PLAN
Scale

SECOND FLOOR PLAN
Scale

FIRST FLOOR PLAN
Scale

GROUND FLOOR PLAN
Scale

Herbert L. Bass & Co., Architects.

PLANS FOR KING'S DAUGHTERS' HOSPITAL, MADISON, IND.

(*Continued from page* 249.)

square-glass pattern is 3⅜″ square on the top and 4″ square on the bottom, making the concrete beam which supports them look in cross section like an inverted pineapple. Another make is 3¼″ square on the top, and the bottom consists of one to four prisms. Most of these square sidewalk lights run from ⅞″ to 1½″ in thickness and from 2¾″ to 5½″ square. The round make, although not capable of giving as great a glass area, are, as a rule, easier to replace. One manufacturer has a metal rim that is embedded in the concrete and acts as a holder for the glass, and when it breaks, it can easily be replaced by another. Still another is based on the screw pattern which permits the removal of the old and the replacing of it by the new. Most of them are 2⅝″, 3″, and 3½″ in diameter.

The material into which the sidewalk lights were formerly embedded was cast iron, but now it is reinforced concrete which has been waterproofed. A mixture of one part of cement to one or one and a half of sand is the general formula. "I" bars of 1¾″ average are set 4¾″ o. c. to reinforce the long beams, and the cross beams are reinforced with 5/16″ bars. Some makes have sheet-metal forms, and these use only ¼″ rods.

The usual load which a sidewalk light is supposed to carry is 300 pounds per square foot or a concentrated load of 5 tons on one point. As most of the makes exceed this strength, they may be considered safe, although the stronger they are the better they will resist the squeeze from contraction of adjoining sidewalks. For 6′ spans some are capable of sustaining 1,000 pounds per square foot.

Among other glasses used for the diffusing of light are ground glass, maze, Florentine or figured, rippled, and rough plate. They are not intended to deflect the light as prism glass but to give a translucent effect and diffused light.

Another one of the developments of glass is the use of an opaque milk-white variety of plate glass for structural purposes. This is a polished glass which is fused at a temperature of 3,000° Fahrenheit and thoroughly annealed. It gives a brilliant, sanitary, non-crazing, non-absorbent surface which is impervious to stains and has always a fresh appearance. It is excellent for wainscot and structural partitions in toilets, office-buildings, apartment entrances, hospitals, swimming-pools, tops of counters, linings for refrigerators, etc. It has a distinct advantage over the sanitary tile in that it reduces the jointing to a minimum and does not show any signs of crazing.

The use of colored glass in the building is now only for very choice decorative treatments, and should be handled by experts in this line, for nothing gives a cheaper effect than colored glasses used crudely. Only the most expert makers of leaded-glass windows have survived the gradual elimination of the general use of this art in the average building. The so-called art glass is of great variety, however, and a few of the important ones will be mentioned.

Most colored glasses which are inherently colored and not stained or painted appear as the richest, and they are given their colors by the presence in them of some metal oxide. The same oxide will give, at different temperatures, different colors. Oxide of iron will give all the colors of the rainbow, but the commonest are green and orange. Manganese gives pink or amethyst, but at higher temperatures brown, yellow, and green. Copper affords the cheap ruby glass, and at higher temperatures purple, blue, and green. Cobalt affords the blue or black. Gold makes ruby, violet, and amber, where one part is used in one thousand parts of glass. The opalescent glass is formed by cryolite, arsenic, or tin. Flashed glass is made by dipping the original glass bubble into a bath of molten colored glass, and then making the sheet glass from it in the ordinary way. Opaline glass is made by pouring colored glass upon white opaque glass, and then pressing the same together under rollers. Stained glass is secured by applying soluble metal oxides to the surface with a brush, and then burning them into the glass by placing in a kiln. Painted glass is produced by enamels applied to the surface, which are then fused to it.

Some other glasses, used to a certain extent in connection with art glass, differ on account of their method of making and composition. For instance, crown glass is a relic of the past, but for ornamental purposes is often used. The glass is blown into a spherical bubble, and then this bubble is opened and made to revolve at great speed. Centrifugal force causes the glass to take the shape of a flat disk, but the centre nodule always remains as a lump. Formerly, all the glass except this was used, but now it is this centre nodule which is used for the ornamental effect. Lead flint glass is used in all the finest cut glass, and is made from lead and potassium silicates. Bohemian glass is made from potassium and calcium silicates; Venetian from sodium, potassium, and calcium.

Probably the most far-reaching invention in glass for buildings was the development of wire glass. When an ordinary window is attacked by fire, the first thing that happens is the shattering and the falling out of the glass. Wire glass was invented to prevent this dangerous breakage, and its use as a fire-stop was an afterthought, although many believe the reverse is true. The National Board of Fire Underwriters defines wire glass as follows: glass not less than ¼″ thick enclosing a layer of wire fabric reinforcement having a mesh not larger than ⅞″, and the size of the wire not smaller than No. 24 B. & S. gauge. Frank Shuman secured the first really successful patent for making this glass in 1892. It is cast on steel tables, kept hot by gas flames beneath. The molten glass is poured over it in quantities of a ton or so. Wire mesh is also heated to a temperature nearly equal to the glass. A vehicle with four rollers passes over it then, feeding the wire into the glass. The first roller smooths out the molten glass, the next roller presses the wire deep into it, and the last two rollers smooth it out again. The glass is then in the rough-plate condition, and is often sold like this. It is generally polished, though, or its surface is stamped with one of the many figured patterns common to pressed glass, such as ribbed, maze, cobweb, etc. The customary extreme sizes are 720 square inches and not more than 48″ wide. A standard of 5/16″ thickness is adopted, but there are also thicknesses of ¼″ and ⅜″.

Wire glass is practical to use in any window, door, or enclosure where it is desirable that, in case of fire, it should not be shattered. It should not, however, be used in skylights, over elevators, stairways, dumbwaiters, or vent or light shafts. In these places a thin glass should be used which is protected with wire at least 6″ above it, and having a mesh of not more than 1″. No glass has had more influence on the safety of buildings than this wire glass. It has made possible many changes in plan that would not have been thought of if this distinctly modern invention had not been placed upon the market. Along a similar line, new inventions are being developed for non-shatterable plate-glass show-windows which will resist the shock of objects striking them. Such glass will mean the elimination of large insurance on plate glass and reduce the vast wastage which goes on in this direction every year.

Notes on Steel Construction

By DeWitt Clinton Pond, M.A.

MY last two articles were about theoretical considerations which form the basis for many engineering calculations. In this article the practical applications of these principles will be given. Although the articles which will appear later will deal largely with concrete construction, and will be written for architects who will be interested in this type of work, this one will be devoted to steel construction, as even in buildings which are considered as being built entirely of reinforced concrete there will be places where steel shapes will be used.

Formulas and methods have been given which will enable the architect to determine the tendency toward bending in a beam if this tendency is caused by an external load. The resisting tendency in the beam has been considered only in the case of a wood beam, and this formula was given as $M = S \times \frac{1}{6}bd^2$. This formula was derived from a more complex one, known as the *flexure formula*, and which forms the basis for the design of all steel beams. The flexure formula is $M = S \times I/c$. M is the bending moment, which may be found by the formula $M = \frac{1}{8}Wl$, or by the methods given in the last two articles. S is the safe working strength of the material in the beam. In the case of a wood beam this was taken as 1,200 pounds per square inch. In the case of a steel beam this is universally considered as 16,000 pounds per square inch. The architect should consult the building code, or ordinance, of his city or State to verify these amounts.

It might be noted in passing that the amount of 16,000 pounds is arrived at by pulling a steel bar, having a cross-sectional area of one square inch, apart. It is found that the force necessary to do this varies from 54,000 pounds to 67,000 pounds, with the average force determined as 64,000 pounds. A factor of safety of 4 is always used for steel, so the *safe working stress* of steel is considered as 16,000 pounds, or 8 tons per square inch.

The next factor in the formula is the fraction I/c. This fraction is given the somewhat mysterious name of "section modulus," and I is known as the "moment of inertia." The author has found that these names do more to discourage students than much of the hard work encountered in the study of engineering. One could take a large amount of space in deriving the flexure formula, in discussing the moments of inertia of different cross-sections, but the limits of this article will not permit of this. The actual application of the formula and the methods of finding the moments of inertia of steel shapes are very simple, and this discussion will be confined to these items.

When the architect desires to design steel structures he must make use of the Carnegie "Pocket Companion" or the Cambria handbook. There are tables in "Kidder" which also give the necessary information. The handbooks are revised and edited every year or so, as it will be impossible to refer to specific pages, but reference will be made to headings in the indexes.

Referring to the index of the "Pocket Companion," the heading "Elements of Sections" can be found, and the pages devoted to tables giving the various dimensions and elements of I-beams, angles, and channels are listed in such a manner that the architect can speedily find them. In the Cambria book the same tables are listed under the general heading of "Properties."

In all the tables the properties or elements are listed in much the same manner. First, the depth of the I-beam or channel, or the dimensions of angles are given. In the next column in Cambria are tabulated the various weights of I-beams and channels and the thicknesses of angles. These two columns might be considered as index columns, as I-beams are always referred to by their depths and weights, as are also channels, while angles are referred to by the lengths of their legs and their thicknesses. As an example of this an I-beam is referred to as a 24-inch, 100-pound I-beam, and a channel will be known as a 15-inch, 40-pound channel. An angle might be designated as a $6 \times 6 \times \frac{1}{2}$-inch angle. By looking through the tables the reader can find all these shapes listed.

Among the other headings listed under "Properties" or "Elements" will be found one listed as "Moment of Inertia," or I in Carnegie, Axis 1–1, and in the next column, "Section Modulus," or S in Carnegie, Axis 1–1. This moment of inertia is the "I" referred to in the flexure formula, and this can be found for any steel shape by simply referring to the handbooks, and the same is true of the section modulus. A brief explanation of this last term might not be out of place, however.

It will be noted that the section modulus is designated by the fraction I/c. c is known in engineering parlance as the distance from the neutral axis to the most remote fibre of a cross-section. In the case of a beam having a section that is symmetrical with regard to its neutral axis, c will equal one-half the depth. In the case of a 24-inch, 100-pound I-beam, or, for that matter, any 24-inch beam or girder, c will equal 12 inches. The moment of inertia of a 24-inch, 100-pound I-beam is given in the handbooks as 2379.6. As c has already been found to be 12 inches for such a beam, the fraction I/c becomes $2379.6 \div 12 = 198.3$. By referring to the column headed "Section Modulus" in the Cambria, or S in the "Pocket Companion," the amount 198.3 is found to be this property for the beam under consideration.

Such calculations are simple for I-beams and channels, as these sections are symmetrical with regard to their Axes 1–1. As such beams and channels are only occasionally laid flat, Axis 1–1 is the one that is usually used.

With regard to angles, either leg might be turned up, and it might be well to determine the section modulus around both axes. As an example, a $6 \times 4 \times \frac{1}{2}$-inch angle will be selected, and it will be found by referring to the table that the distance from the 1–1 Axis to the back of the longer leg is .99 of an inch, and from Axis 2–2 to the back of the shorter leg is 1.99 inches. The distance from Axis 1–1 to the most remote fibre will be found to be $4 - .99 = 3.01$ inches, and from Axis 2–2 to the most remote fibre $6 - 1.99 = 4.01$ inches. The moments of inertia around these two axes are 6.27 and 17.40, respectively, and the section moduli can be found by dividing the moments of inertia by their respective distances, or $6.27 \div 3.01 = 2.08$, and $17.40 \div 4.01 = 4.33$. These results can be verified by reference to the tables.

The question might properly be asked, what is the practical value of all this? By glancing back at the flexure formula, it can be seen that with S always regarded as 16,000 pounds, and the section modulus given for any particular beam, the bending moment can be easily determined. Usually the reverse process is used, however.

Let it be assumed that in a storage warehouse all the partition walls are to be built of 8-inch brick. In some of the partitions it is desired to insert metal sash, and in some cases this sash is 15 feet long. It will be assumed that there are 6 feet of brickwork above the sash, and this must be carried on two angle-iron lintels.

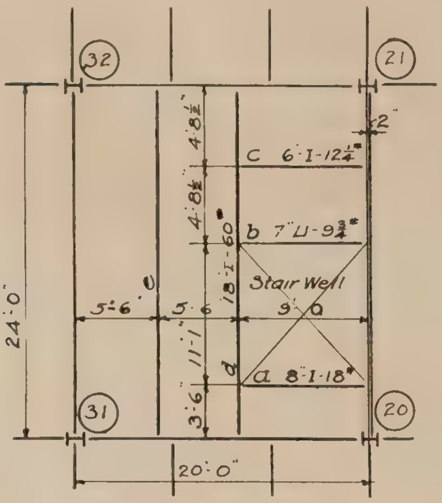


FIGURE XIII

In this case the span, l in the formula, is 15 feet. The load—W—can be found by multiplying the cubic feet of brickwork by the weight of a cubic foot, or by 120 pounds. $15 \times 6 \times \frac{2}{3} = 60$ cubic feet. $60 \times 120 = 7{,}200$ pounds. This load is the "W" in the formula $M = \frac{1}{8}Wl$. As the span "l" equals 15 feet, or 180 inches, the tendency toward bending can be found to be $M = \frac{1}{8} \times 7{,}200 \times 180 = 162{,}000$ inch-pounds. All this is worked out in accordance with the methods given in the last two articles. Once the external tendency toward bending is determined in this manner, it is only necessary to equate it with the flexure formula to determine the size of the angles. As S, in the flexure formula, is always taken as 16,000 pounds, the equation becomes $162{,}000 = 16{,}000 \times I/c$. It will be noticed that I/c is the only unknown quantity, and by carrying out the proper calculations, this can be found to equal 10.1. As there will be two angle-iron lintels used to carry the wall, each angle will have to have a section modulus equal to one-half this, or 5.05. By looking in the table for "Elements" or "Properties" of angles with unequal legs, and by glancing down the column marked "Section Modulus," Axis 2–2, three angles will be found having section moduli slightly more than 5.05. A 5-inch by $3\frac{1}{2}$-inch by $\frac{15}{16}$-inch angle, or a 6-inch by $3\frac{1}{2}$-inch by $\frac{5}{8}$-inch angle, or a 6-inch by 4-inch by $\frac{5}{8}$-inch angle might be used. The second one, however, having a section modulus of 5.19 and a weight per foot of 18.9 pounds, should be selected.

It will be seen that there is nothing particularly intricate or involved about this work. Another method of solving the above problem is by use of the safe-load tables. Referring to the index, the heading "Safe loads, tables of, for angles used as beams," in Cambria, or "Angles, safe loads, tables," in Carnegie, will be found, and in the tables on the pages listed in the index the safe loads for different angles for various spans are given. As in the problem, the angles were placed with their long legs in a vertical position, the table giving the safe loads for angles with unequal legs with the neutral axis parallel to the shorter leg will be used. The total load of brick was found to be 7,200 pounds. The load carried by one angle will be 3,600 pounds, and the span is 15 feet. In the tables of safe loads the first columns are used to list the spans in feet. Looking down these first columns for spans of 15 feet, and then across to the safe loads, the angles that will carry 3,600 pounds are the ones given above, and only the last two will have the safe loads listed above the horizontal black line.

These horizontal lines are important, as any load listed below them will cause too great deflection, which is given in most building codes as $\frac{1}{360}$ of the span. Methods of determining the deflection in beams will be given later.

The reader can see that by the use of the safe-load tables he arrives at the same result as he did by the use of the flexure formula, and the process is much simpler. He may ask why he should not always use the safe-load tables in preference to the more complex method. In problems involving uniform loads such as the one just given, the use of the safe-load tables is to be recommended, but where concentrated loads are encountered these tables cannot be used, and the flexure formula is the only one that will answer.

As an example of such a problem, it might be well to investigate the design of the beams in the floor panel shown in Fig. XIII. The architectural plan for which the steel is designed is shown in Fig. XIV. In this panel the columns are spaced 20 feet by 24 feet, and there is an opening for a stair-well. The floor load will be considered as 200 pounds per square foot, including both dead and live loads. The load on the stair panel will have to be taken as 100 pounds live load, according to the New York code, and as the dead load—the weight of the stair construction—will probably be about 100 pounds per square foot, the load on this panel will also be taken as 200 pounds. The diagram shown in Fig. XIII will have the beams designated as a, b, c, d, and e, and 20–21 and 31–32. The girders will be designated as 32–21 and 31–20.

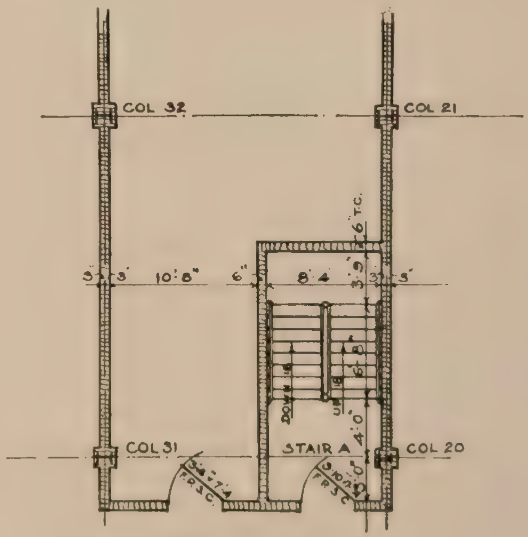


FIGURE XIV

The load on beam a can be found very easily by determining the area of floor that the beam will carry, and multiplying this area by 200. This area will measure 7 feet $3\frac{1}{2}$ inches by 9 feet and 2 inches, and will contain 66.5 square feet. It will weigh 13,300 pounds, and the beam that will carry this load will be an 8-inch, 18-pound I-beam, as determined by consulting the safe-load tables. Beam *b* will carry a smaller floor panel, but will have to carry a 6-inch terra-cotta wall. The floor will weigh 4,274 pounds, and the partition, which is 9 feet 2 inches long, 10 feet high, and weighs 30 pounds—plastered—per square foot, will weigh 2,748 pounds. The total load will be 7,022 pounds, and the safe-load tables will show that a 7-inch, 9.75-pound channel will carry this load over a span of 9 feet. Beam *c* will simply have to carry twice the floor load on beam *b*, and will be a 6-inch, $12\frac{1}{4}$-pound I-beam.

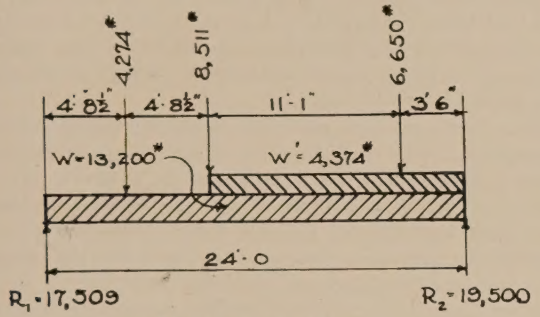


FIGURE XV

All the beams designed above were found by means of the safe-load tables. Beam *d*, however, must be designed by means of the flexure formula and the section modulus. There will be a uniformly distributed load over this entire beam due to the floor load between beams *d* and *e*. This floor panel will measure 2 feet 9 inches by 24 feet, and will have an area of 66 square feet and a weight of 13,200 pounds. The terra-cotta wall will extend over 14 feet and 7 inches of the beam and will weigh 4,374 pounds, and beam *a* will add a concentrated load of one-half its total load, or 6,650 pounds. Where beam *b* frames into *d*, one of the hangers carrying the stair construction will also be framed to *d*. This hanger will carry one-fourth of the stair load, or 5,000 pounds. The total load where *b* frames into *d* will be 8,511 pounds. Beam *c* will add one-half of its load, or 4,274. The conditions of loading are shown in Fig. XV.

The first consideration in the design of the beam is the finding of the reactions. The methods used in the last article should be used, and the loads listed and multiplied by their respective lever-arms as follows:

	4,274 × 4.7	= 20,088	foot-pounds
	8,511 × 9.42	= 80,173	"
	13,200 × 12.0	= 158,400	"
	4,374 × 16.7	= 73,045	"
	6,650 × 20.5	= 136,325	"
Totals	37,009	468,031	"

By dividing the total moment by the span—24 feet—R_2 can be found. 468,031 ÷ 24 = 19,500 pounds = R_2.

By subtracting R_2 from the total load, R_1 can be found. 37,009 − 19,500 = 17,509 = R_1.

The next step is the drawing of the shear diagram. This is shown in Fig. XVI, and it can be seen that the shear changes sign at a point where beam *b* frames in. This will be the point of maximum bending moment. In order to find this it will be necessary to determine the upward of positive moment caused by R_1. 17,509 × 9.42 = 164,934 foot-pounds.

The negative moments will be caused by the downward loads, or the uniformly distributed load at the left of the point of zero shear, or 5,181 pounds, and the concentrated load where *c* frames into *d*, which is 4,274 pounds. When these loads are multiplied by their respective lever-arms and the total subtracted from 164,934, the maximum bending moment is found to be 120,497 foot-pounds, or 1,445,964 inch-pounds. By dividing this amount by 16,000 the section modulus of the beam is found. I/c is found to be 90, and the beam will be an 18-inch, 60-pound I-beam.

Beam *e* can be easily designed. The load on it is a uniform one, as it carries a floor panel measuring $5\frac{1}{2}$ feet wide by 24 feet long. The area of this panel is 132 square feet and the weight is 26,400 pounds. In the uniform load tables it will be found that a 15-inch, 45-pound I-beam will be strong enough to carry this load.

The only other members of this panel will be the girders, but the type of calculation that will be used for the determination of the sizes of these is exactly the same as that used in the case of beam *b*, and no further explanation will be given.

Reference was made above to deflection in beams. This is sometimes important, as it is the practice of some architectural offices to use a standard size for all angle-iron lintels. In one office it is customary to use 4 inches by 3 inches by $\frac{5}{16}$-inch angles in all cases where it is possible. This size, either used as a single angle or as two angles back to back, can be used in almost all cases for windows having openings up to 5 feet wide, but when long spans are encountered there might be too great tendency toward deflection. If a steel member is loaded to its carrying capacity, with a uniform load, it is not difficult to determine whether the deflection is too great. The loads listed below the horizontal black lines in the safe-load tables will cause this, and it is only necessary to refer to these tables. When, however, it is desired to use a standard-size angle that is more than strong enough to carry its load, but which might have too great deflection on account of a long span, then it will be necessary to use the formula:

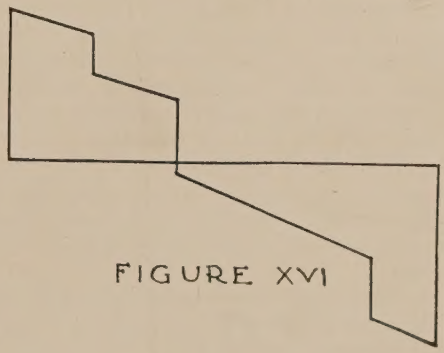


FIGURE XVI

$$D = \frac{5}{384} \times \frac{WI^3}{EI}$$

This formula looks complicated and is a long one to work through, but is not as difficult as it appears. *D* is used to designate the deflection, *W* is the total uniform load, and *E* is a complex sounding thing, entitled the Modulus of Elasticity, in pounds, per square inch, while *I* is the now familiar moment of inertia.

The Modulus of Elasticity is always taken as 29,000,000 for steel. This is all that the reader has to know about it unless he happens to be of an inquisitive turn of mind, in which case he is referred to any standard text-book on engineering. An actual example will show how the formula can be used.

Suppose it is desired to use a 5-inch by $3\frac{1}{2}$-inch by $\frac{5}{16}$-inch angle to carry a load of 1,000 pounds over a span of 15 feet. By looking at the safe-load table it is possible to determine that the angle will easily carry this load, but as the safe load for a span of 15 feet—1,380 pounds—falls below the horizontal line, it is doubtful whether the angle will carry 1,000 pounds without deflecting too much.

By substituting in the formula the actual deflection will be obtained.

$$D = \frac{5}{384} \times \frac{1{,}000 \times 180 \times 180 \times 180}{29{,}000{,}000 \times 6.6} = .39$$

The allowable deflection is $\frac{1}{360}$ of the span, or 180 ÷ 360 = .5, so the standard angle will carry the load within the allowable deflection. It might be noted that the span in the above formula is given in inches, and that the moment of inertia of the angle is taken around its 2–2 Axis, and was found to be 6.6.

The formula looks difficult to work through, but it will be found to be very simple if one is at all familiar with the process of cancelling.

This article deals only in a cursory manner with the subject of steel construction, but as this subject has been given a much more extended discussion in the original articles on "Engineering for Architects," this is all the space that can be given to it here.

The next articles will deal with reinforced-concrete construction. This subject has already been treated in articles appearing in ARCHITECTURE in 1916–17. If the reader is not familiar with these, it would be well for him to glance back over his old volumes before attempting to investigate the problems presented in the following articles. These will deal with actual problems encountered in the design of one of the largest reinforced-concrete buildings erected in the country.

Announcements

We acknowledge with pleasure the handsome and comprehensive catalogue of "Architectural Interior and Exterior Woodwork Standardized," published by The Curtis Companies. Its profuse and admirable illustrations of correct architectural woodwork, designed for all types of homes, should prove a welcome reference in every architect's library. It covers every detail of various type houses, both exterior and interior. Doorways, windows, mantels, panelling, china-closets, sideboards, stairways and stair parts, door and window frames, porches, mouldings, etc. The work shown was developed under the general direction of the well-known architectural firm of Trowbridge & Ackerman in collaboration with other leading members of the profession.

The appointment of Doctor F. H. Newell, head of the Department of Civil Engineering at the University of Illinois, and past president of American Association of Engineers, as director of field forces during the summer months was one of the most constructive measures passed at the quarterly meeting of the Board of Directors of the American Association of Engineers on June 19. Doctor Newell will spend a large proportion of his time in travelling, and will assist the chapters in solving their problems of organization and expansion, and assist them to prepare for rendering greater service.

The national employment committee was instructed to formulate a personnel card and prepare plans for the expansion of employment service.

Samuel A. Hertz, architect, announces that he is now located in his new offices at 15–17 West 38th Street, New York City.

Mills, Rhines, Bellman & Nordhoff, architects, 1234 Ohio Building, Toledo, Ohio, announce the admission to partnership of Chester B. Lee, July 1, 1920.

The consolidation is announced of Westinghouse, Church, Kerr & Co., Incorporated, and Dwight P. Robinson & Co., Incorporated, under the name of Dwight P. Robinson & Company, Incorporated, engineers and constructors, with general offices, 125 East 46th Street, and down-town office, 61 Broadway, New York. Branch offices are in Chicago, Cleveland, Pittsburgh, and Dallas.

Bollard & Webster, architects, Omaha, Nebraska, advise us that they have removed their office from 303 McCague Building to 521 Paxton Block.

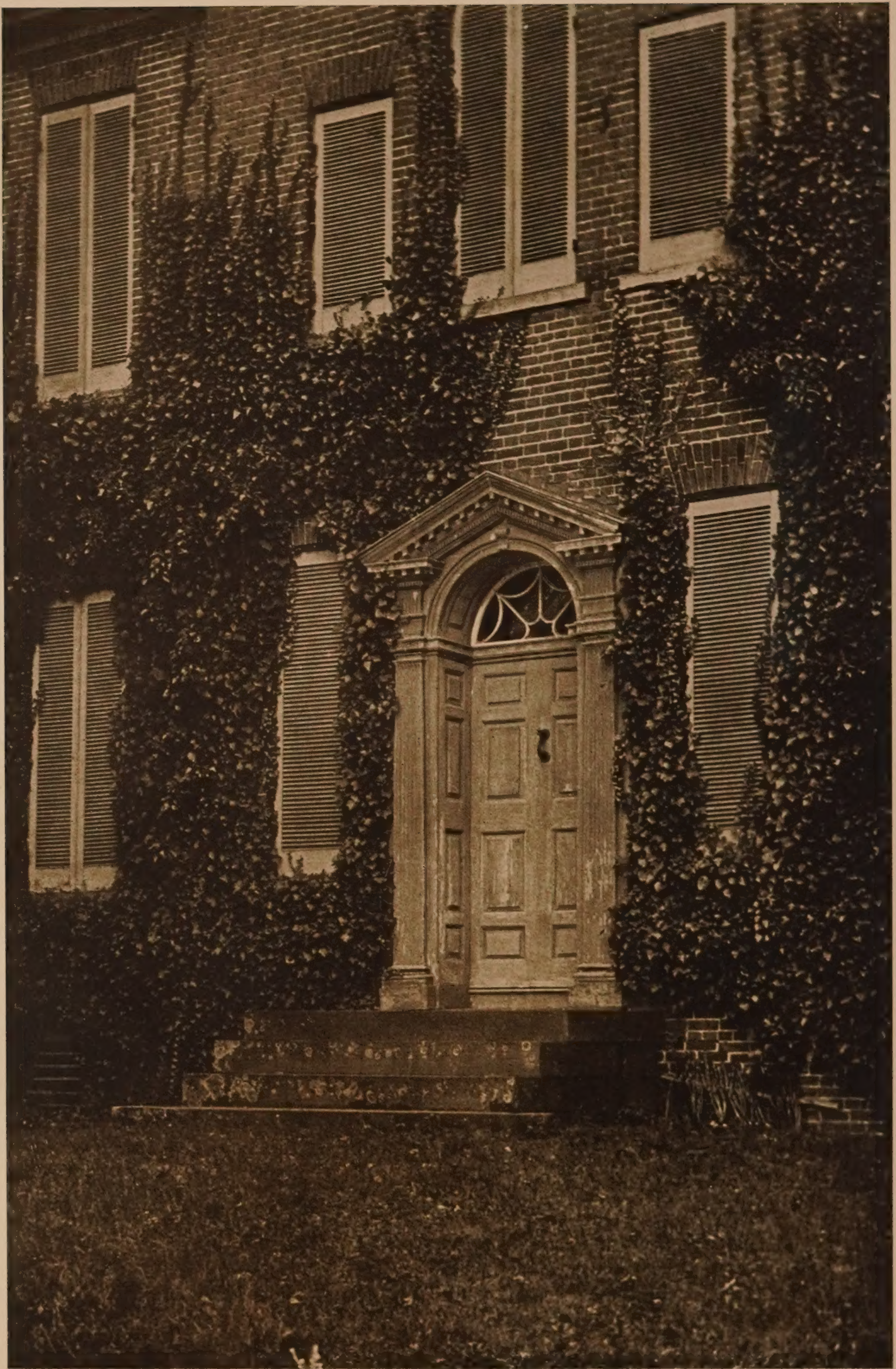
We regret to announce the recent death of Russell A. Griffin, general sales manager of the National Pole Company. Mr. Griffin was well known among telephone people. He was for many years connected with the American Telephone and Telegraph Company, and later with the Western Electric Company, before going into the pole business.

Rossel Edward Mitchell & Company, Ltd., Norfolk, Va., have moved their main office to 817 Fourteenth Street, N. W., Washington, D. C. Manufacturers' catalogues for filing purposes are requested.

In answer to a number of inquiries, we take pleasure in saying that the beautiful photographs of the reredos and woodwork of St. Thomas's Church published in the July number were made by Kenneth Clark.

Three Mental States that Lead to Accidents

THERE are three mental conditions which have a vital bearing on the prevention of accidents. The first is the widely prevalent taint of epilepsy which may cause a man to lose consciousness momentarily and put his hand into a place of danger. The second is the curious effect of habit noted by Doctor D. H. Colcord, in the *Scientific American* for June 12: "A man operating the levers of a crane, oiling a lathe in motion, driving an automobile, or crossing a crowded thoroughfare, may at a dangerous moment continue to act as accustomed by habit, thus occupying the nervous machinery with habit-chains which present conscious control." The third is another mental twist, known to all of us, by which the fear of what would happen if a man should jump off a high building, or drive an automobile into a tree, becomes an uncontrollable impulse to do that very thing.



POPLAR HILL, PRINCE GEORGE COUNTY, MD.

From a photograph by Albert G. Robinson, author of "Old New England Houses."